A PROSPECTIVE OBSERVATIONAL STUDY TO ASSESS THE INCIDENCE OF POSITION RELATED INJURIES AND INCIDENTS IN PATIENTS UNDERGOING UROLOGICAL PROCEDURES UNDER ANAESTHESIA

A dissertation submitted in partial fulfilment of MD Branch X, (Anaesthesiology) examination of the Tamil Nadu Dr.MGR Medical University, to be held in April 2015

DEPARTMENT OF ANAESTHESIOLOGY
CHRISTIAN MEDICAL COLLEGE
VELLORE

CERTIFICATE

This is to certify that the dissertation entitled — A **PROSPECTIVE OBSERVATIONAL STUDY TO ASSESS THE INCIDENCE OF POSITION RELATED INJURIES AND INCIDENTS IN PATIENTS UNDERGOING UROLOGICAL PROCEDURES UNDER ANAESTHESIA** is the bonafide original work of **DR SUNIMAL BHAGGIEN** submitted in fulfillment of the rules and regulations for the MD Branch X, Anaesthesiology examination of the Tamil Nadu Dr.MGR Medical University, to be held in April 2015.

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ABSTRACT

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A prospective observational study to assess the incidence of position related injuries and incidents in patients undergoing urological procedures under anaesthesia

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The aim of the study was to measure the incidence of position related injury and positioning related incidents and to analyse the risk factors associated with the injuries.

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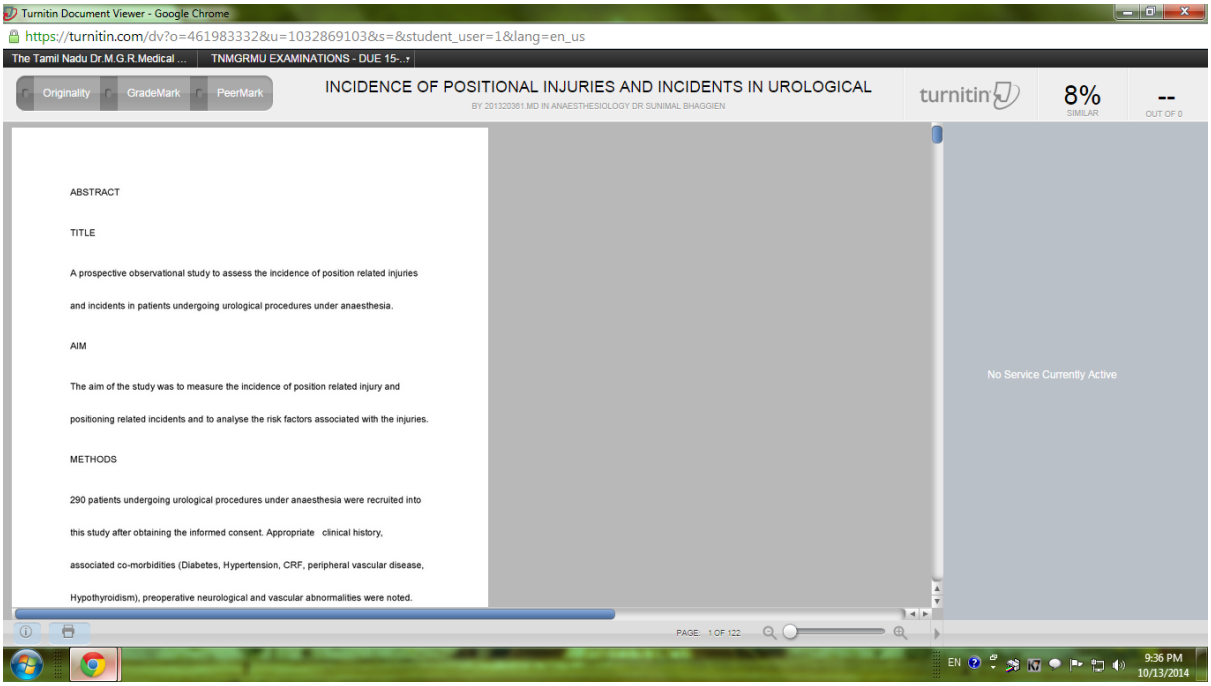
290 patients undergoing urological procedures under anaesthesia were recruited into the study after obtaining the informed consent. Appropriate clinical history, associated co-morbidities (Diabetes, Hypertension, CRF, peripheral vascular disease, Hypothyroidism), preoperative neurological and vascular abnormalities were noted. The anaesthetic management (general anaesthesia/regional anaesthesia/combined/conscious sedation) for the urological procedure was as per the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Incidence of position related injuries and incidents in patients undergoing urological procedures under anaesthesia.
Dr. Sunimal Bhaggien, PG Registrar, Dr. Georgene Singh, Dr. Tony Thomson Chandy, Anaesthesiology, CMC, Vellore.

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Dear Dr. Sunimal Bhaggien,

I enclose the following documents:-

1. Institutional Review Board approval 2. Agreement

Could you please sign the agreement and send it to Dr. Nihal Thomas, Addl. Vice Principal (Research), so that the grant money can be released.

With best wishes,

Dr. Nihal Thomas
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Dear Dr. Sunimal Bhaggien,

The Institutional Review Board (Blue, Research and Ethics Committee) of the Christian Medical College, Vellore, reviewed and discussed your project entitled "Incidence of position related injuries and incidents in patients undergoing urological procedures under anaesthesia." on August 4th 2014.

The Committees reviewed the following documents:

1. IRB Application format
2. Curriculum Vitae' of Drs. Sunimal Bhaggien, Georgene Singh, Tony Thomson Chandy.
3. Proforma
4. Informed Consent form (English, Tamil, Telugu & Bengali)
5. Information Sheet (English, Tamil, Telugu & Bengali)
6. No of documents 1-5

The following Intitutional Review Board (Blue, Research & Ethics Committee) members were present at the meeting held on August 4th 2014 in the CREST/SACN Conference Room, Christian Medical College, Bagayam, Vellore 632002.

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Dr. Rajesh Kannangai	MD, Ph D.	Professor & In-charge Retrovirus Laboratory (NRL under NACO), Department of Clinical Virology, CMC, Vellore	Internal, Clinician
Dr. Anup Ramachandran	Ph. D	The Wellcome Trust Research Laboratory Gastrointestinal Sciences, CMC, Vellore	Internal, Basic Medical Scientist
Dr. Simon Pavamani	MBBS, MD,	Professor, Radiotherapy, CMC, Vellore	Internal, Clinician
Dr. Vivek Mathew	MD (Gen. Med.) D.M (Neuro) Dip. NB (Neuro)	Professor, Neurology, CMC, Vellore	Internal, Clinician
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We approve the project to be conducted as presented.

The Institutional Ethics Committee expects to be informed about the progress of the project, any **adverse events** occurring in the course of the project, any **amendments in the protocol and the patient information / informed consent**. On completion of the study you are expected to submit a copy of the **final report**. Respective forms can be downloaded from the following link: http://172.16.11.136/Research/IRB_Polices.html in the CMC Intranet and in the CMC website link address: http://www.cmch-vellore.edu/static/research/Index.html.

Fluid Grant Allocation:

A sum of 4,000/- INR (Rupees Four Thousand only) will be granted for 6 months.

Yours sincerely

Dr. Nihal Thomas
Secretary (Ethics Committee)
Institutional Review Board

Cc: Dr. Georgene Singh, Anaesthesiology, CMC, Vellore

ACKNOWLEDGEMENTS

I wish to express my heartfelt thanks and deep sense of gratitude to my guide Dr. Georgene Singh, Department of Anaesthesiology, CMC, Vellore for all her encouragement and guidance at every stage of this study and preparation of this dissertation.

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A special thanks to my family, especially my wife Mrs Sherin for her support and my son Samuel who bore my absence during the completion of this dissertation.

I am grateful to God for his Grace which sustained me during the entire Course of this study.

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AIM

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290 patients undergoing urological procedures under anaesthesia were recruited into this study after obtaining the informed consent. Appropriate clinical history, associated co-morbidities (Diabetes, Hypertension, CRF, peripheral vascular disease, Hypothyroidism), preoperative neurological and vascular abnormalities were noted. The anaesthetic management (general anaesthesia/regional anaesthesia/combined/conscious sedation) for the urological procedure was as per the clinical judgment of the anaesthetist concerned. The operative position was decided by the urologist and the anaesthetist. The nature of position, time taken to position, number of people involved and the positioning aids used were noted. Any adverse

hemodynamic changes or incidents occurring during or after the positioning were noted (change in Mean Arterial Pressure/ heart rate ± 20% of baseline in five minutes). The positioning aids used like prone pillows, axillary rolls, armrests/arm boards, saline bags, jelly rests were noted. At the end of the surgery the patient was be re-examined for any injuries or incidents related to positioning. Any of the following injuries such as chemosis, conjunctival injury, corneal injury, blindness, peri-orbital edema, extremity motor/sensory deficit, brachial plexus injuries, gangrene and compartment syndrome were looked for. Any critical incidents during positioning such as duration of loss of effective monitoring due to monitor dislodgement, endotracheal tube dislodgement, kinking, accidental extubation, dislodgement of venous and arterial lines will be observed.

Factors contributing to positional injury were categorized as patient related, procedure related, position related and anaesthesia related. The management of these injuries and their progress was also followed up. The incidence of these injuries and incidents were assessed and the risk factors associated with them were analyzed.

RESULTS:

In our study only one patient sustained nerve injury. We did not observe any neuromuscular injury to patients in laparoscopic procedures, but the incidence seen for position related injuries in all the urological procedures is about 2.1 % which is slightly less than the above study. Injuries reported were redness of eyes ,chemosis, periorbital edema, lip edema, lower limb edema and sensory neuropraxia.

More injuries occurred in patients who had general anaesthesia(3.1%) compared to spinal anaesthesia (0.72%).Longer duration procedures were more associated with nerve injuries and the percentage of injuries were more in those with low BMI . In our study the incidence of position related incidents was also observed. The incidence was seen to be 3.4 %. The most common haemodynamic event observed was hypotension requiring vasopressors and it was more prevalent in those undergoing General anaesthesia.

CONCLUSION

In this study our aim was to know the incidence of position related injuries and incidents in urological procedures under anaesthesia. We have observed that the incidence of injuries related to position is 2.1 % which is less than previous studies done on urological procedures. Most of the injuries reported were in the eyes and head like chemosis, periorbital edema lip edema. The only nerve injury which occurred was sensory neuropraxia where the patient complained of numbness in the lateral aspect of the left leg observed post operatively. The patient had undergone redo anastomotic urethroplasty under general anaesthesia. This was due to the long duration of procedure (> than 6 hours) in the lithotomy position.

We have also observed the incidence of incidents related to positioning in urological procedures and found the incidence is about 3.4%.The reported incidents were hypotension, bradycardia, endotracheal/ LMA tube dislodgement ,tube kink, accidental extubation and cautery burns. The most frequent one was hypotension. Airway issues were also significant. The significant incident which could have been avoided was the cautery burns which occurred in a patient who underwent left open radical nephrectomy under combined general and epidural anaesthesia. The patient recovered well from the insult and did not report any morbidity.

In our study it was found that more injuries and incidents happened when general anaesthesia was administered. Moreover, patients undergoing procedures in the in prone position were more vulnerable to injuries(11%) and position related incidents also(11%). It is interesting to note that all the injuries and events in prone occurred in patients undergoing PCNL ((Percutaneous nephro lithotomy). Hence, more care and precaution need to be taken when a patient undergoes this procedure in prone.

In this study, it was obvious that procedures of short duration were relatively safe from position related injuries. Longer duration surgeries were more susceptible to injuries and incidents due to positioning. Hence, care must be taken when positioning a patient for longer procedures and all standard precautions must be undertaken.

We observed that the patients who had a low BMI were more at risk for injuries and incidents due to positioning than those in the normal or high BMI. This is probably because since obesity is a known risk factor for position related injuries, more precautions were taken to avoidposition relarted incidents. We would like to conclude that the thin patient is also at a higher risk of position related injury.

In conclusion, it must be stressed that positioning related injuries and incidents under anaesthesia can go unrecognized and utmost care must be

taken to avoid the occurrence of these injuries and incidents. These are more common in patients undergoing long procedures under general anaesthesia and those undergoing PCNL in the prone position. Hence it is important to counsel patients undergoing surgeries about the rare possibility of positioning injuries and incidents especially in long surgeries. Although the incidence of position related injury is less compared to the Western population, continuiung the study to achieve a larger sample size which was originally intended would throw more light on the incidence of position related injury and incidents, especially in the Indian subcontinent.

AIM AND OBJECTIVES

AIM:

The aim of this study is know the incidence of position related injuries and incidents in patients undergoing urological procedures under anaesthesia.

OBJECTIVES:

The primary objective is to assess the incidence of position related injury and positioning related incidents and to analyze the risk factors associated with positioning related injuries.

The secondary objective is to study the time taken for the injury to resolve and their management.

INTRODUCTION

Patient positioning before a surgical procedure involves a combined effort of the surgeons and the anaesthesiologist. In fact the entire operating team shares the responsibility. It is of prime importance to maintain a balance between optimal surgical positioning and the safety of the patient.

Though patient positioning for optimal surgical access is vital, many of these positions can induce adverse physiological consequences which can affect the haemodynamics of the patient. This can result in significant cardiovascular and respiratory compromise especially in patients with associated co-morbidities. More over under anaesthesia the compensatory mechanisms of the human body are compromised. One common undesirable physiological change is hypotension due to decreased venous return to the heart. The other one commonly seen is oxygen desaturation due to ventilation perfusion mismatch. There are also injuries and insults that can occur due to poor patient positioning(1) .The commonly occurring injury appears to be peripheral nerve injury of which ulnar neuropathy is the commonest(2).

A retrospective study conducted by Welch MB et al for a 10 year period showed that injuries due to urological procedures constituted 15 % of all the cases reported and 13 % of all the peripheral nerve injuries that were reported (3)

Urological procedures under anaesthesia involve different kinds of positions and proper positioning is vital to the surgeons operating to reach the retroperitoneal and pelvic organs.

The commonly adopted positions involved in urological procedures are:

- Supine -This position used for most open urologic procedures.

  Examples are surgeries of the scrotum, penis, testis, inguinal lymph nodes, open bladder surgeries, ileal conduit, prostatectomy, adrenal glands etc.

  Some of these procedures are modified with a trendelenburg position for better visualization of the lower abdominal viscera.
- Lithotomy –This position is used for transurethral procedures like ureterostomy, urethroplasty etc. It is also used for open procedures involving the perineum, anus or proximal urethra.
- Lateral decubitus position-used for access to the kidneys, collecting systems and adrenal glands. Examples are laparoscopic nephrectomy, open nephrectomy, adrenalectomy etc.

- Prone positioning- used for access to the retro peritoneum and upper urinary tracts. Common surgeries performed are percutaneous nephrolithotomy, adrenalectomy,lumbotomy etc.

PHYSIOLOGICAL CHANGES DUE TO POSITIONING:

In a healthy individual to blunt the effects of positional changes complex arterial ,venous and cardiac physiological responses come into picture. This maintains perfusion to the vital organs .

When a patient changes the position from erect to supine, the venous return to the heart is increased. Hence the preload, cardiac output,and stroke volume increases. This in turn increases the blood pressure and thru the baroreceptors on the aorta and the carotid sinus causes a decrease in the sympathetic outflow and increase in the parasympathetic response of the heart. Thus there is a compensatory decrease in the heart rate, cardiac output and stroke volume. So in an unanaesthetised individual during postural changes the blood pressure is maintained within a narrow range. General anaesthesia, neuraxial blockade interferes with these auto regulatory mechanisms and renders the patient vulnerable to the changes in haemodynamics. For example neuraxial blockade like spinal anaesthesia causes significant sympathetic block which reduces the preload and blunts the cardiac response to the decreased sympathetic output.

In General anaesthesia where positive pressure ventilation is used changes can occur due to increased intrathoracic pressure. This can decrease the pressure gradient from the peripheral capillaries to the right atrium which can subsequently affect the cardiac filling and decrease the cardiac output. With associated conditions like COPD, bronchial asthma, obesity and ascitis, the intrathoracic pressure is further aggravated and worsens the venous return and the cardiac output.

Hence frequent measurement of blood pressure and prompt treatment is vital during positioning. Prompt administration of vasopressors or IV fluids plays a role during this crucial period. Sometimes a head down position helps. Often it is prudent to delay the positioning till the patient attains stable haemodynamics.

Under anaesthesia ,spontaneously breathing patients have a low tidal volume and functional residual capacity. The use of muscle relaxation and positive pressure ventilation helps in maintaining the minute ventilation and preventing atelectasis and thus minimize ventilation perfusion mismatch.

In spinal anaesthesia or epidural anaesthesia only the abdominal and the thoracic muscle function is lost in the affected dermatomes. The diaphragm is not affected here. It is also important to note that any particular position that limits the movement of the chest wall, diaphragm or the abdomen can

lead to atelectasis and increase in the intrapulmonary shunt. The change in position from erect to supine reduces the functional residual capacity due to cephalad displacement of the diaphragm. The ventilation contributed by the diaphragm also decreases in supine position.

The prone position is used to access the retro peritoneum and upper urinary tract. The commonly performed urological procedure is the percutaneous nephrolithotomy. Care taken during positioning avoids adverse hemodynamic changes. In this position if the legs are in plane with the upper trunk, hemodynamic reserve is maintained. Tilting of the head end of table upwards or downwards has shown to decrease or increase the venous return respectively. Similarly lowering or raising the legs will induce the same changes. If the head is positioned at a level lower than the heart, venous drainage from the head may be impaired. Facial edema has been noticed in such cases especially in prolonged procedures and when there is vigorous fluid administered. In such cases laryngeal edema can also be present and it is prudent to wait till the edema subsides before extubation. In prone position when the head is rotated excessively, blood flow in the carotid and vertebral arteries can get reduced. Care must be taken especially in patients with compromised flow in these arteries to minimize the rotation of the head(4).

Positioning with chest rolls or pillows can cause increased abdominal venous pressure (5). In prone patients it is not wise to allow spontaneous ventilation as the work of breathing is more. It has also been noticed that oxygenation improves in prone position especially in individuals with respiratory failure(6). Here the functional residual capacity is not much decreased when compared to the supine or lateral position. At the same time severe hypoxia can happen when patients are turned prone. This can be due to other causes like endotracheal tube migration into main stem bronchus, accidental extubation and hypoventilation. The hypoventilation can be due to abdominal compression due to improper positioning. There can be increased pulmonary and systemic vascular resistance and subsequently a decrease in venous return. The stroke volume and the cardiac index is decreased but the blood pressure, the central venous pressure and the pulmonary artery occlusion pressure does not change much when compared to the supine position. Since venous return decreases after changing to prone position, preventive measures like venous compression stockings, wrapping of the legs, fluid challenge can be considered.

LITERATURE REVIEW

Positioning for any surgery is vital for surgeon for the best surgical access. At the same time safe positioning is important for both the surgeon and the anaesthesiologist to minimize the risk of injuries to the patient (7). Urological procedures involve different kinds of positions as these procedures involve surgeries in the retro peritoneum and pelvis.

In order to access these deep structures various surgical approaches are practiced – open, Laparoscopic, Endoscopic and robotic. These are done in different positions. Some of the commonly used positions in urological procedures are – supine, prone, lateral, lateral decubitus, lithotomy and high lithotomy. Many of these are modified with the vertical tilt (trendelenburg or reverse trendelenburg)(7).

The American society of Anesthesiologists formed a closed claims project in 1984 to evaluate the adverse outcomes and studied files from 35 U.S insurance companies. Here it was found that the incidence of nerve injury to be 18 % of all the claims of which ulnar neuropathy was the most frequent(28%)(1). In this out of the 143 urologic claims studied, ten nerve injuries (7%) were directly related to patient positioning.

In a study by Wolf et al in urological laparoscopic procedures, there was a 2.7% incidence of neuromuscular injuries(8). Position related injuries are more prevalent in robotic assisted urological surgeries with an incidence of 6.6%(9)

Patient positioning is typically attended to after administration of either regional or general anaesthesia and placement of arterial and venous lines. Hence the protective mechanisms of our body are not in vogue. It is the combined responsibility of both the anaesthesiologist and the surgeon to ensure that the patient is positioned in a physiologically acceptable position without injury and with adequate surgical exposure.

Positioning of the patient for urological procedure is challenging and requires adequate anaesthetic depth, maintenance of hemodynamic stability, evidence of appropriate oxygenation and preservation of invasive monitoring.

Table 1 below gives an idea of the different types of position related injuries on different parts of the human body during the period of the urological procedure and post operatively.

Table -1 Types of position related injuries

Eyes	Redness	conjunctival injury
	Chemosis	Decrease in visual acuity
	Corneal injury	Blindness
	Periorbital edema	
Head and Neck	Skin peeling	Lip edema
	Soft tissue injury	Chin necrosis
	Ear/nose injury	
Chest and abdomen	Skin peeling	Nerve injury
	Soft tissue injury	Deep vein Thrombosis
	Compartment syndrome	
Vascular	Loss of peripheral pulses	
	Gangrene	
Brachial plexus and upper limbs	Palsy	
	Paresis	
	Limb edema	
	Compartment syndrome	

Table 2 shows the various incidents that can occur during or right after positioning the patient for surgery.

Table 2 : Position related incidents

Hemodynamic changes	Hypotension Bradycardia
Airway issues	Edotracheal tube/LMA dislodgement Tube kink Accidental extubation
Cautery burns	Based on the position where the cautery plate is placed
Venous access	Loss of arterial wave form Malfunction of venous access
Loss of effective monitoring	Depends on the duration of positioning when monitoring was not possible

Mechanism of position related injury

Position related injury can be due to :

1. Tissue compression
2. Blunt or sharp trauma
3. Air embolism
4. Organ under perfusion (10)

POSITION RELATED NERVE INJURY:

Nerve injury can happen any time during the surgical procedure or post operatively as well. It may or may not be related to positioning . It can happen during invasive procedures like central line insertion, arterial line placement, intramuscular injection, regional anaesthesia techniques such as spinal or epidural anaesthesia and direct trauma in the field of surgery. These may not be due to positioning. Positioning related nerve injuries are usually preventable and were first documented in the 1800s(11). In the American society of closed anaesthesiologists claims study has shown that nerve injuries comprised of about 15 % of all the claims. In this ulnar nerve was involved in one third of all the injuries, brachial plexus in 23 % and the lumbosacral in 16 %(2).

Pathophysiology:

Peripheral nerve injuries usually manifest when there is stretch of the nerve, compromised blood supply to the nerve or compression at the time of surgery.

Nerve injury is the one commonest injury encountered in urological procedures .There are two major classification systems by which nerve injury is classified.

The Seddons classification

1.Neuropraxia:

It is caused by temporary occlusion of the blood supply to the nerve which can result in reversible conduction block .

2. Axonotemesis - loss of axonal continuity - stretching of the nerve

3. Neurotemesis - severance of the entire nerve (12) .There is no continuity and it has poor prognosis.

The Sunderland s classification: It is divided into five types of injuries based on the connective tissue parts which are destroyed.(13)

The severity of the nerve injury depends on the type of injury. If there is minimal stretching of the nerve causes patchy nerve ischemia due to mild compression of the intraneural blood vessels. Here if there is temporary loss of blood supply to the nerve can cause conduction block which can be reversed(14)

Table 3 gives a comparative classification of nerve injuries

Table 3: Comparative classification of nerve injuries

Seddons	**Sunderland**	**function**	**pathophysiology**	**prognosis**
Neuropraxia	Type1	focal conduction block	Local myelin injury,axonal continuity, no wallerian degeneration	Recovery in weeks to months
Axonotemesis	Type2	Nerve conduction at injury site and distally is lost	Axonal continuity is disrupted with wallerian degeneration	For recovery there is need of axonal regeneration. Good prognosis
	Type3	Nerve conduction at injury site and distally is lost	An axonal continuity and endoneurial tube is lost. The perineurium and epineurium are intact.	Scarring due to disruption of the endoneurial tubes, edema and hemorrhage. Poor prognosis may require surgery.
	Type 4	Nerve conduction at injury site and distally is lost	Axonal continuity ,endoneurial tubes and perineurium is lost.	Guiding elements disorganized. Axonal misdirection and intraneural scarring. Poor prognosis. Surgery needed.
Neurotmesis	Type 5	Nerve conduction at injury site and distally is	The entire nerve is cut	The nerve ends need to be surgically modified.

		lost		Guarded prognosis. Depends on the nature of insult and local factors

More severe stretch disrupts the intraneural connective tissue causing intraneural hemorrhage and necrosis. This can eventually lead to elevated intraneural venous pressures producing endoneurial edema. Axonic flow may be impaired which causes sustained dysfunction which can lasts for hours to weeks(15)

Further prolonged pressure can progress to Schwann cell damage and paranodal myelin displacement which can progress to segmental or demyelination. Here recovery in terms of remyelination can happen only after several weeks.

More severe damage occurs when there are higher pressures which end in axonal loss and wallerian degeneration. Here there is no conduction involved at the distal segment at all. Total axonal loss results in denervational changes in the muscle. This can be seen in the EMG. The most severe injuries which occur rarely due to positioning involve total disruption of the nerve for which axonal regrowth is impossible.

Predisposing factors:

- Pressure on the nerve
- Thin patients
- Diabetes mellitus
- Pre existing peripheral neuropathy-from diabetes, peripheral vascular disease or other causes.
- Subclinical neuropathy
- Hereditary neuropathy
- Hypothermia
- Prolonged hypotension
- Under nutrition /malnutrition
- Anatomical variations-cervical rib(16)(12)
- Tourniquet use
- External compression on nerve-table surfaces, tourniquet, blood pressure cuffs,retractor,masks,straps, leg stirrups etc.

Nerve injury evaluation:

Physician awareness in important in this setting. Since in the immediate post operative period it is often missed due to post operative analgesia , sedation or maybe due to post operative pain also. Once nerve injury is suspected a detailed history should be taken with special mention on the predisposing factors. A proper history will guide us determine the timing and the progress

of the symptoms. It can also help in ascertaining the mechanism of injury as well. A thorough examination with a special mention of the neurological examination is conducted as well. A consultation with the neurologist can be sought if a neurological deficit is identified.

If there is positive finding on physical examination electromyography might be indicated to identify and localize the lesion. It explores the sensory and motor nerve conduction velocities and the degree of muscle denervation and reinnervation. EMG (electromyography) can be performed to differentiate between acute and chronic nerve injury. The aim here is to distinguish the nerve injury(due to positioning) from other injuries occurring due to neurological disorders,cervical spinal injuries and other autoimmune neurological disorders(17).

One of the commonest differential diagnosis of brachial plexus injury which can present postoperatively is acute brachial plexitis. It's a disorder of the brachial plexus of unknown etiology. Its incidence annually is over 1.6 cases per 100000. It can commonly occur in after surgery, in pregnancy,trauma, vaccinations ,systemic immune responses(18). The clinical presentation is acute with rapid onset of severe shoulder pain, continuous in nature with radiation to the arm. It usually lasts for weeks and subsides by itself but soon muscle weakness and wasting may be seen. The upper trunk is commonly

involved. It is usually associated with hyporeflexia and sensory deficits along the affected area. A good clinical examination ,electromyography and exclusion criteria will help in clinching the diagnosis. EMG done after three weeks of onset may show denervational changes. EMG done later at three months can show signs of reinervation like polyphasic potentials. Treatment includes analgesics and physiotherapy. The recovery takes months to years since it requires axonal regrowth.

Points to differentiate brachial plexitis from positioning nerve injury:

- Brachial plexitis usually affects bilaterally
- EMG- multifocal changes in brachial plexitis, whereas in nerve injury it will be confined to the distribution of the nerve.
- In brachial plexitis there can be delay in onset of the neurological deficit whereas positioning nerve injuries can present immediately after recovery from anaesthesia(18).

Treatment of positioning related nerve injury

- Pain due to the injury is treated with analgesics and drugs used for neurogenic pain like gabapetin.
- Physiotherapy plays an important role to treat motor deficits. It helps maintaining flexibility of the joints and the range of motion.
- Use of affected muscles is advice

- The use of a splint on the affected limb to protect from further damage will also help in preventing contractures.
- Document recovery with EMG s taken periodically
- Clinical evaluation to be done periodically
- Surgery indicated in refractory lesions- neurolysis,resection and grafting, transposition of the nerve etc.

Brachial plexus injury:

This type of injury is one of the earliest reported injury related to position. It is most frequently related to stretching of the cord. Excess arm abduction, external rotation and displacement of the shoulder posteriorly can cause stretch of the brachial plexus. One predisposing factor may be extension and lateral flexion of the head to one side in supine position. The other position which can likely cause injury is the arm abduction, external rotation and extension of the arm by accidental dropping of the arm away from the side of the body. Abduction of the arm above 90 degree in situations where the hand rests above the head also lead to stretch on the roots of the plexus (19). Compression is the other mechanism of this type of injury. It can occur when the clavicle moves upward when the sternum is retracted. In urological procedures especially in the lateral decubitus position compression plays a role since the plexus is pressed between the axilla and the shoulder .

Another cause of compression is the presence of the anatomical variant-the cervical rib.

The use of steep trendelenburg in urological procedures with the help of shoulder braces can cause severe stretch and compression of the brachial plexus(20).

In prone position brachial plexus injury can occur if there is excessive arm abduction above 90 degree(21).

Ulnar nerve injury:

The ulnar nerve due to its superficial path along the medial epicondyle of the humerus is more common than the brachial plexus. The position at risk for compression is the extended and pronated forearm, flexion of the elbow across the chest. It is found to be more common in males due to the narrow cubital tunnel and/or the increased mobility of the nerve. Surprisingly it has been also observed that ulnar neuropathy can occur without any cause despite careful positioning and proper padding(22)

Common peroneal nerve injury:

In the lower limb this is the most commonly damaged nerve. The mechanism is by compression of the fibular head in the lithotomy, position, between the operating table and the fibula and in the lateral decubitus position . Both compression and stretch mechanisms were seen to be

involved. In one study despite adequate preventive measures injury to the peroneal nerve was reported. Risk factors identified were recent history of smoking, thin body habitus, and prolonged duration of surgery. The other mechanism of injury in the lithotomy position is the hip flexion with knee extension that stretches both the common peroneal nerve and the sciatic nerve(23). The lateral decubitus position has also been shown to cause peroneal nerve palsy. In this particular case the patient underwent left nephrectomy during which he sustained the injury. The right head of the fibula compressed against the operating table. In this case recovery took a year(24). Similar cases have also been noticed .

Compartment syndrome:

The other injury that can occur due to severe and prolonged tissue compression is compartment syndrome . This is a potentially devastating complication of long urological surgeries though not a common occurrence. In urological procedures compartment syndrome can be considered as a preventable complication. At the same time the affected limb can undergo severe ischemic damage with disability and risk of death if emergency decompression surgery is not undertaken(25) . The commonest position in urological procedures where this complication is commonly seen is the lithotomy position(26). The first report of compartment syndrome in

lithotomy position was by Leff and Sharpio in 1979 (27). Simms MS et al studied the incidence of fatality in compartment syndrome and found that it can be fatal in 6% cases and lifelong morbidity in 41.5% cases (28).The incidence here was reported to be one in five hundred cases .

Pathophysiology of Nerve Injury:

Due to prolonged tissue compression from improper positioning can cause ischemia and edema of the surrounding tissues which compress the capillary vessels and the veins which results in secondary perfusion failure.

This hypo-perfusion is due to increased intracompartmental pressure (ICP) (25).

The ICP is normally between 0-10 mm of Hg at rest and the CCP (capillary perfusion pressure) is 25-30 mm of Hg . Either increase in ICP or decrease in CPP can reduce the blood flow and will completely stop if ICP rises above the CPP. This ischemia leads to edema and further increase in ICP . The injury cycle is augmented by reperfusion of ischemic tissues which leads to formation of oxygen free radicals, thromboxanes and prostaglandins. This worsens ischemia by promoting platelet aggregation and micro vascular clotting. Compartment syndrome can lead to ischemia damage neuropathy and rhabdomyolysis(29)

If it is not detected early and treated it can lead to permanent injury, multi organ failure, and renal failure and can be even fatal at times.

In supine and lithotomy position ,the ICP increases as the calf muscle is compressed by the legs resting on the operating table or on the leg stirrups. Moreover the perfusion pressure is lowered due to leg elevation and this depends on the degree of elevation. This further compromises perfusion and is further aggravated by Perioperative hypoxia, blood loss, hypotension and decreased cardiac output. The risk of compartment syndrome further increases and is directly proportional to the duration of surgery.

Another position where leg perfusion is compromised is the steep head down trendelenburg position. The leg perfusion can be worsened by angulation at the groin and knee joints which compromises arterial inflow and venous return . There is additional compression on the calf muscle with a steeper head down tilt position which increases the ICP further. Other associated risk factors seen to increase the ICP are obese limbs, muscular limbs , the use of anti- embolic stockings and intermittent pneumatic leg compression devices(30,31) . ICP pressure increases have also been noticed in the lateral decubitus and the full renal- break positions (32). One of the greatest compromised positions for the legs is the very steep trendelenburg position commonly used for laparoscopic radical nephrectomy. In addition the

insufflations of carbondioxide into the abdomen act against the arterial flow and the venous return.

So the commonly seen risk factors are patient with high body mass index and the position associated with it is lateral decubitus , exaggerated lithotomy, reverse trendelenburg (25). The other risk factors are patients with peripheral vascular disease , prolonged surgery , intraoperative hypotension , acidemia, and frequent use of vasoconstrictors.

Diagnosis :

As mentioned before the signs and symptoms of compartmental syndrome should be recognized and there should be a high index of suspicion in recognizing and treatment should be conducted at the earliest. Some of the early signs are

- Local pain not proportionate to clinical findings
- Tense calf muscles
- Neuralgia and parasthesia (particular to the nerve compressed).
- Rapid deterioration due to ischemia and reperfusion occurring in a vicious cycle

Late signs are

- Paralysis

- Loss of peripheral pulse
- skin changes

If there is rhabdomyolysis, creatinine kinase levels are more than 2000 IU. As a result myoglobinuria is evident(33). The most specific marker is Carbonic anhydrase 3 assay.

Management of Compartment Syndrome:

Compartment syndrome should be treated as an emergency . It is treated based on the severity.

- Surgical decompression by fasciotomy is advocated in severe cases.
- Mannitol is also administered, which acts as a free radical scavenger, and osmotic diuretic.
- To prevent urate and myoglobin precipitation urine should be alkalinized.
- Dialysis can also be done for refractory renal failure(33).

Prevention :

- To keep the period of trendelenburg position as short as possible.
- Avoid lithotomy positions longer than four hours for normal patients and three hours for patients with vascular insufficiency(31,33).

- During prolonged limb surgery to advocate frequent periods of limb lowering for reperfusion and to help reduce ischemic changes in the limbs.
- To use contoured gel pad with full leg supporting lithotomy stirrups. This helps in even distribution of limb weight to the heels ,ankles and calves.
- In high risk patients to consider measurement of ICP.

THE POSITIONS USED IN UROLOGICAL PROCEDURES AND THEIR ASSOCIATED COMPLICATIONS.

SUPINE:

Even though supine position is the most common position in surgery , it can still result in injuries related to the position(10). The urological procedures commonly done in supine position are surgeries on the scrotum, penis, inguinal lymph nodes ,open bladder surgery, ileal conduct, augmentation cystoplasty, ureteric reimplant, open adrenelectomy etc. surgeries such as nephrolithotomy PCNL can also be done in supine position for patients who are at high risk of complications due to proning (29). The risk groups are morbid obesity, cardiac problems, COPD and other co morbidities.

Figure 1:The supine position- The upper limbs are kept over the trunk of the patient. They can also be abducted and kept on arm boards. Care must be taken not to hyper abduct the arms above 90 degree.

Ulnar nerve is the most commonly associated ($1/3^{rd}$ of the peripheral neuropathies) neuropathy in the supine position(1,10). It is observed to be the more common in men than women. Since women have more fat around the elbow , and the larger tubercle of the ulnar nerve (34,35). Symptoms can be delayed in patients with a median onset time of three days after surgery(1).The upper limbs should be properly positioned and pressure on the ulnar groove should be minimal.

Ideally the arms should be extended neutrally or slightly supinated(36). Flexion of the forearm> 90 degree can compress on the ulnar nerve. Pronation and extension of the arm can also compress on the ulnar nerve. One has to make sure that the blood pressure cuffs are properly placed and not distal so that it does not press on the ulnar nerve while inflating(37).

Arm tucking can be avoided in obese patients as it can lead to compartment syndrome. Tucked arm should be kept in neutral positions(36). Even though the mechanism of ulnar nerve injury is not completely understood , stretching compression and double crush injury (subclinical) have been postulated (38). It can occur even in awake patients .

The next common nerve bundle to be injured in supine position is the brachial plexus. Risk factors identified for brachial plexus injury are the following :

- Arms abducted > 90 degrees.
- Arms on arm boards which do not support horizontally (dorsal extension of the shoulder stretches the brachial plexus)
- Lateral flexion of the head away from the affected arm(39).

Thus to avoid to brachial plexus injury head should be straight , arms struck in neutral position, medially rotated and tucked under the sheet or positioned

laterally and abducted not more than 90 degree. Arms should be placed on strong arm rests that prevent dorsal hyperextension(11).

The other injury which can occur in supine position is the radial nerve injury due to pressure on the spiral groove of the humerus. It is usually caused by accidental hanging of the supinated arm off the table. It can also occur if the blood pressure cuff has displaced distally. If the arm is pronated and hanging, it can injure the median nerve.

In certain urological procedures the table is broken at the level of anterior superior iliac spine. This is to expose the retro peritoneum. Here spinal hyperextension can occur in supine position, and this can be hazardous to the patients with lumbar spine or disc problem. So spinal hyperextension beyond a physiologic degree should be avoided.

There is not much data on the overall rate of upper extremity injuries in urological injuries. In general the peripheral nerve injury rates have been between 0.14% to 13%(16)

There is an isolated report of three brachial plexus occurring with radical retro pubic prostatectomy done on 113 cases with the arms placed laterally on arm boards and with the arms were secured across the chest, and it was seen that no peripheral neuropathies were reported(40) .

The following are the recommendations from the American society of Anaesthesiologists task force on prevention of Perioperative upper extremity peripheral nerve injuries:

- Padding of the arm boards especially at the elbow.
- Arm abduction to not more than 90 degree
- Arms are positioned in a way as to decrease the pressure on the ulnar groove of the humerus
- To avoid prolonged pressure on the spiral groove of the humerus
- A neutral or supine position is maintained when arms are on the arm boards.
- To avoid overextension of the elbow(the comfortable range of motion to be assessed preoperatively)(41)

The other injuries which can occur in the supine position can be due to the trendelenburg tilt given to displace the viscera upwards and improve the visualization of the renal and pelvic organs. This position causes increase in central venous pressure, intracranial pressure ,pulmonary venous pressure and intraocular pressure. A decrease in functional residual capacity and pulmonary compliance is noticed as well(42). Prolonged duration of surgery in this position pools blood into the veins of the upper extremities which result in edema of the head and neck. In this scenario the anaesthesiolgist

can encounter problems like laryngeal edema which may require re-intubation(43).

PION(posterior ischemic optic neuropathy) is another complication in the trendelenburg position. The possible mechanism is due to ischemic insult to the optic nerve(43,44). This is due to multiple factors like hypoxia, increased blood loss, prolonged hypotension, fluid overload, increased venous pressure and the presence of other comorbidities(45) (46).

To avoid brachial plexus injury due to the shoulder braces, a non sliding mattress can be used(39).

THE LITHOTOMY POSITION:

In urological procedures, the lithotomy position is used frequently for transurethral procedures and even open surgeries to expose the perineum, proximal urethra and anus. The foot end of the table is broken at the level of the anterior superior iliac spine and the leg stirrups are placed at the level of the knees angled to the contralateral shoulder. The upper limbs can be tucked in the sides, placed over the chest o extended laterally. Care is to be taken to avoid trauma to the fingers while moving or reattaching the foot end of the table.

Figure 2:The Lithotomy position

In the classic lithotomy position the hips are flexed at 80-90 degree and legs are abducted to 30-45 degree laterally. Knees are bend so that the lower legs are parallel to the floor. In exaggerated lithotomy position the perineum should be almost parallel to the floor. Back should be supported with the help of a buttress(46).

Figure 3: Lithotomy position- leg stirrups used as a positioning aid.

The commonest nerve to be injured in lithotomy position is the common peroneal nerve due to compression of the head of the fibula and the leg stirrups. So the knees can be padded to avoid compression injury on the nerve. The other nerves which can be involved in this position are the saphenous nerve, the sciatic nerve, obturator and the femoral cutaneous nerve. The medial tibial tubercle can cause compression of the saphenous nerve. The sciatic nerve can be stretched by hyper flexion of the hip and

extension of the knees(29). Risk factors identified for the injuries are tobacco use, slim built, prolonged surgery lasting for more than three hours(47).

Other than nerve injuries compartment syndrome has been seen in surgeries performed in prolonged lithotomy with trendelenburg positions. Prolonged surgery in lithotomy and hypo perfusion has been proposed as the etiological factors(48). In another study done by simms et al, compartment syndrome was found to be rare in procedures lasting for less than 4 hours. Risk factors associated with it were increased blood loss, presence of peripheral vascular disease and obesity(28). Rhabdomyolysis has also been reported after compartment syndrome occurring in urological procedures performed in lithotomy position(49).

It has also been reported occurring in surgeries without the complication of compartment syndrome. Obesity and prolonged duration of surgery has been postulated to be the causative factors(50). It is useful to monitor renal function and urine output in obese patients and in surgeries of greater than four hours duration. Bilden et al studied the risk factors for rhabdomyolysis by measuring the creatinine kinase levels and urine myoglobin levels for patients who underwent urethroplasty in high lithotomy position. In all the

ten patients, creatinine kinase was raised in the post operative period and for one patient the urine myoglobin was positive(51).

The following are the recommendations given by the American society of Anaesthesiologists task force on the prevention of Perioperative peripheral nerve injuries in the lithotomy and trendelenburg positions:

- Avoid sustained pressure on the peroneal nerve at the fibular head.
- To prevent the risk of lower extremity neuropathy the fibular head can be padded.
- A comfortable lithotomy can be assessed prior to surgery to avoid stretch on the sciatic nerve.
- There is no evidence of hip flexion or hip extension increasing the risk of femoral neuropathy.
- There can be increased risk of brachial plexus neuropathy when shoulder braces are used in steep trendelenburg positions(41) .

<u>The high lithotomy position:</u>

Some of the urological surgeries like radical prostatectomy and urethral reconstruction are done in this position as the surgeons have a better access to the perineum. This is done by hanging the patient's feet from high poles. Here the legs are almost fully extended and the thighs are at 90 degree

flexion on the trunk. The common complications seen are neuropraxia,compartment syndrome and rhabdomyolysis.

Figure 4: The high lithotomy position

In this position there more chances of compression or obstruction of the contents of the femoral canal due to the acute angulation of the thighs. The other nerve to be stretched here is the sciatic nerve. In a study conducted on185 patients for urethral reconstruction done in the high lithotomy position, it was noticed that 18(10%) position related injuries were seen of which four of them were severe(49). To help prevent these injuries it is recommended that the operative time in high lithotomy is reduced. It has

been seen that repositioning to high lithotomy only when required also reduced the risk of complications(49).

THE LATERAL DECUBITUS POSITION:

In urological procedures the lateral decubitus position is used to access the kidneys, collecting system and the adrenals. The commonly done surgeries in this position are nephrectomy and pylolithotomy. Here the patient is placed lateral with the superior arm outstretched but not beyond 90 degree and placed over arm rest or pillows. The inferior arm is kept abducted and flexed at the elbow and at an angle not greater than 90 degree at the shoulder(29). The arm board should be in line with the arm with proper padding. If not it can cause stretch or compression on the ulnar or the radial nerve(52). To avoid brachial plexus injury an axillary roll can be placed under the thorax just caudad to the axilla. This minimizes pressure on the brachial plexus of the dependant arm as it prevents compression of the axilla and shoulder. The peripheral pulses of the upper extremities are checked routinely to rule out any possibility of compression of the neurovascular bundle.

Figure 5 the Lateral decubitus position

The patient is then positioned in reverse trendelenburg position and then the table is broken so that the upper part of the body is parallel with the ground. The dependent lower limb is flexed at the hip and knee and a pillow or saline bag is placed between the thighs to prevent hip injury. The body is strapped at the shoulders and waist and the pressure points can be checked to see whether they are padded.

It has been studied that the occurrence of skin breakdown and pressure ulcers are more common with lateral decubitus position when compared with the supine position(53). One of the risk factors noticed was prolonged operative time. Another study reported that male sex, body mass index greater than 25kg/m2, use of fully flexed position, gel padding increased the

skin to surface interface pressures(54). It has also been proved that there is also the risk of rhabdomyolysis with increased interface pressures(8,55). It is seen more frequently in lateral decubitus position than prone and supine positions(8).

Figure 6: The kidney bench position

The kidney bench position:

The kidney position or the flexed lateral decubitus position is one of the types of the lateral decubitus position.

After placing the patient in the lateral decubitus position ,the head end of the table is tilted downward and the table is flexed at the level of the iliac crest.

A kidney rest is used under the dependent iliac crest and this increases the lateral flexion to improve access to the non dependent kidney. Care is taken to strictly stabilize the patient with straps as the patient can shift caudally during the surgery further impeding ventilation to the down-side lung. The legs can be bent or placed longitudinally and a pillow or pads can be placed between the legs to remove pressure from the bony prominences and injury to the peroneal nerve. Additional padding like gels, saline bags can be placed between knees and ankles to reduce chances of nerve injuries and foot drop. To prevent brachial plexus compression an axillary roll is placed appropriately(allow 2-3 finger breaths between the roll and axilla). This roll should extend beneath the scapula posterolaterally. The dependant arm can be placed on padded arm board with the arm abducted to not more than 90 degree and the upper arm can be supported at shoulder height with the help of the stirrups or with pillows or blanket.

The patient is stabilized on the table by securing with tape across the hip. This tape should be between the iliac crest and the head of the femur. The thorax can also be secured with tape but care is taken to place the tape caudad to the axilla so that chest expansion is not compromised.

In a study by yokoyama et al comparing the hemodynamic effects of the lateral decubitus position with the modified kidney rest position under

anaesthesia, it was seen that the lateral position did not produce much changes in the haemodynamics. The kidney position caused significant change in haemodynamics. The changes noticed were:

- Decrease in MAP, right arterial pressure and pulmonary arterial wedge pressure
- Reduced cardiac index and stroke volume index
- Increase in the systemic vascular resistance index
- The increase in SVR and the decrease in venous return could have caused the decrease in the cardiac output.(56)

Wolf et al also studied 1256 laparoscopic urological procedures and found that rhabdomyolysis has been associated with longer operative times, male sex and increased weight(8). In a meta-analysis the overall incidence of rhabdomyolysis in laparoscopic renal surgeries has been stated to be 0.4%-4.9%. risk factors involved were increased body size, prolonged duration of surgery, male sex and lateral decubitus position(57). They have advice that decreasing the time during which the table is flexed and the kidney bar is raised decreases the risk of developing rhabdomyolysis. They have also recommended routine screening of high risk patients for rhabdomyolysis by measuring the creatinine kinase and urine myoglobin levels post operatively at the recovery room for early detection and better outcome.

THE PRONE POSITION:

In urological procedures the procedures the prone position is used to gain access to the retro peritoneum and the upper renal system. Common urological surgeries performed are PCNL(percutaneous nephrolithotomy) and adrenalectomy(sometimes). Position related injuries can occur due to weight bearing by the ventral aspect of the human body and care should be taken to avoid this and reduce the physiological changes induced by this position. The important positioning injuries that can occur in the prone position is eye trauma like corneal abrasion, retinal ischemia etc. The other common injuries are brachial plexus injury, pressure injury to the face, elbows, breasts, knees and genitalia (in males). Brachial plexus injuries can be avoided by keeping the patients arms to the sides before turning prone. Care must be taken to position the head in neutral position and avoid over-extension or rotation to one side. This can cause excessive pressure on the nerve bundle. Hyper abduction at the shoulder should be avoided (arms should be abducted to no more than 90 degree). Since the head of the humerus can press on the plexus in hyper abducted position of the arms(10). The risk of pressure injury can be minimized by providing proper padding to face,knees,elbows and shins.

Figure 7: The prone position-note the prone pillow.

Turning prone should be done with utmost care as rotation of the head can cause ischemia to the carotid and vertebral arteries which can progress to a cerebrovascular accident(58).

Figure 8:The prone position- Note the position of the arms .

The face and the eyes should be taken care of during the turning prone maneuver. The chest can be supported be with pillows or rolls which should cover the thorax till the hip. This should prevent increased abdominal pressure and allow ventilation. In prone position the compliance of the lung is decreased and ventilation can be compromised. Obese patients are at increased risk of high abdominal pressure and this lowers the cardiac output. Additional abdominal support should be provided for the patients. The breasts should be kept medially to avoid compression laterally(58). Lumbar flexion if possible should be avoided as this position can increase the pressure in the face and can cause venous pooling in the legs which can subsequently lead to hypotension and deep vein thrombosis. In patients with compromised cardiopulmonary reserve and in obese patients, prone position should be considered with caution.

Figure 9: The Prone position- note the position of the head (should be kept neutral and not flexed)

Though there are not many publications on complications in urological procedures in prone position, complications occurring after neurosurgery in prone have been published. They are

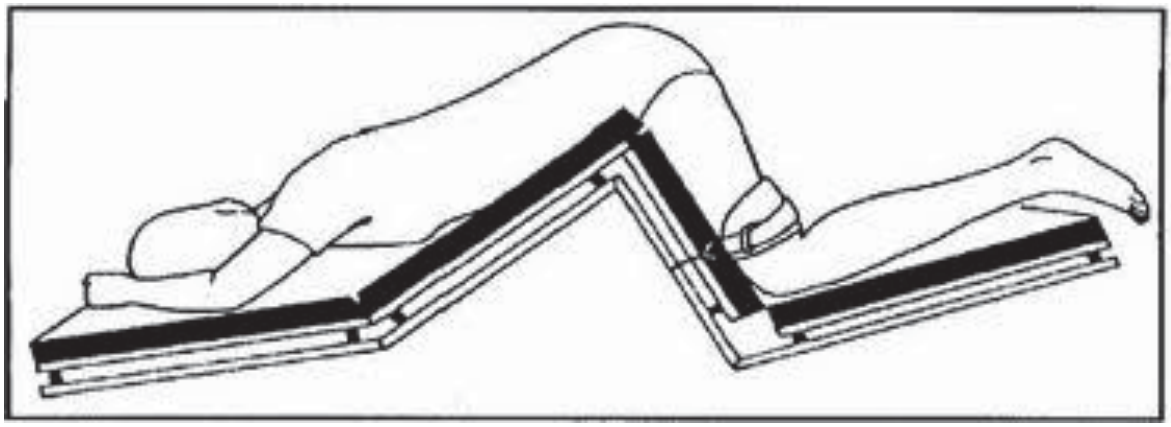
- Peripheral nerve injuries
- Pressure injuries
- Compartment syndrome
- Cardiovascular complications(58)
- PION(posterior ischemic optic neuropathy)(59).

Figure 10: The prone position- note the saline bags kept under the legs

THE JACK KNIFE POSITION:

This position is otherwise called as the kraske position. Here the patient lies flat on his abdomen in prone with the hips flexed and the knees bend at ninety degree. The arms are kept in front of the patient outstretched with elbows flexed and palms down. To raise the chest ,chest rolls can be placed.

Figure 11: The Jack-knife position



This position is usually used in gluteal and anorectal procedures. In urology the jack knife position is used for the modified posterior saggital trans anorectal approach in repair of urogenital sinus anomalies(60)

It was seen that the cardiac index decreased significantly when turning the patient from supine to prone. Then following jack knife positioning following head down rotation the cardiac index was seen to have increased and come back to the same value seen in the supine position. It was also noticed that the heart rate and the mean arterial pressure increased in the jackknife position. These changes however did not present any serious problems to the cardiac function(61). There is also a study done on the incidence of pulmonary atelectasis following upper urinary tract surgery done in jack knife position on patients in different degrees of tilt. The chest radiographs and the decrease in arterial oxygen tension were used for the diagnosis of atelectasis. The incidence was 32.1 % out of the 78 patients

who underwent surgery in the jack knife position(62). Another study compared the impact of prone and jack knife on the intra abdominal pressure, blood loss at the site of surgery, lung mechanics and duration of the surgery. It was seen that less intra abdominal pressure elevation and less bleeding was noticed with the surgeries performed in the jack knife position when compared with the prone position(63).

THE TRENDELENBURG POSITION:

Head down tilt position has been frequently used in laparoscopic urological procedures. It was Friedrich Trendelenburg, a German urologic surgeon who popularized this posture in the 1860s though it was earlier described by Bardenhauer. Trendelenburg described it as" if one places the body of a patient on the operating table in such a way that the pubic symphysis forms the highest point of the trunk and the long axis of the trunk forms an angle of at least 45 degree with the horizontal, then the various organs fall into the concavity of the diaphragm by virtue of their weight"(42).

In un-anaesthetized healthy individuals the trendelenburg position has been shown to increase central venous pressure and cardiac output without increasing heart rate or systemic vascular resistance due to the carotid and aortic baroreceptors that respond reflexly with systemic vasodilatation and bradycardia (64,65). On patients with cardiac compromise or in sepsis

studies did not show much benefit on the haemodynamics with the 30 degree tilt.

The carotid arterial arterial blood pressure and the cerebral blood flow were shown to decrease in the anesthetized dog. This can be hazardous when compounded by inadequate pulmonary ventilation or hyperventilation which further impairs the cerebral circulation. This effect of the intracranial pressure on patients with cerebral tumor or head trauma must be monitored with greater caution. IV fluid administration must also be restricted in patients in this position as it may lead to edema of the head and neck.

It was studied that a modest trendelenburg position under pneumoperitoneum does not change the cerebral blood flow- co2 reactivity under sevoflurane anaesthesia when compared to supine position(66).

The legs in this position must be freely supported as they are also vulnerable to circulatory dysfunction leading to pulmonary embolism and venous thrombosis. Therefore they should not be strapped tightly. The leg in flexion even with non binding supports carries a risk of venous stasis.

The arms can also be injured in this position as nerve compression is possible if the arm extension is above 90 degree so as to stretch the brachial plexus. The use of shoulder braces can also impinge on the brachial plexus.

The other peripheral nerves like the ulnar and the radial can also be protected by adequately padding the armrests.

Respiratory dynamics in head down position:

Head down position by itself has not shown compromises in the respiratory function. There is a tendency to develop atelectasis, edema and pulmonary congestion when left atrial pressure increases in relation to alveolar pressure. This is minimized with the use of PEEP of 5 cm H2O. These changes are seen more in elderly,obese,debilitated patients.

The displacement of the endotracheal tube is another issue to be considered in this position. It does not always move upwards as it is firmly anchored but rather can move low into the trachea as the lungs and the carina are displaced upwards due to pressure from the diaphragm. This results in migration of the endotracheal tube to the right main stem bronchus resulting in hypoventilation of the left lung(67). So care must be taken to see that the cuff of the endotracheal tube is just below the vocal cords.

The improvement in hypoxemia and gravity dependent perfusion to the alveoli of the upper lobe in critically ill patient with lower lung contusion and flail chest has been recorded(68)

The steep trendeleburg position:

This position provides adequate surgical exposure for robotic prostatectomy. A decrease in functional residual capacity, pulmonary compliance and total lung volume has been observed in patients under light anaesthesia with a 45 degree head down tilt.

A study done to see weather steep trendelenburg position and co2 pneumoperitoneum compromises cerebral hypo perfusion was proved otherwise(69). It was also noticed that the cerebral perfusion pressure and the regional cerebral oxygenation was well maintained within the limits where the cerebral blood flow is auto regulated(70).

POSITIONING DURING LAPAROSCOPIC PROCEDURES:

For many urological procedures surgery is being performed with the help of a laparoscope. Now it is a field that is well established in urology. The common surgeries performed with a laparoscope are voluntary donor nephrectomy, nephroureterectomy, radical and partial nephrectomy, pelvic lymph node dissection etc. Now due to the many advantages of laparoscopic procedures many patients prefer it to the open surgery. The benefits include

- Less tissue trauma
- Better post operative pain relief

- short hospital stay
- better cosmetic results

Laparoscopic surgery is done by insufflation of carbon dioxide into the peritoneal cavity creating a pneumoperitoneum. Thus the intra-abdominal pressure is increased. The rate of insufflation of the gas is 4-6 liter per min which maintains a pressure of 10-15 mm Hg. Carbon dioxide is used since it is nonflammable, colorless and non toxic. Since carbon dioxide is highly soluble it is safe if there is an occurrence of a venous embolus.

Physiological effects of positioning in laparoscopic urological surgeries:

Some urological laparoscopic procedures like laparoscopic radical prostatectomy, cystectomy etc use the trendelenburg position for optimum surgical access. Thus there is further reduction in functional residual capacity,V/Q mismatch and increased chances of atelectasis. Thus cardiac output is increased due to increase in venous return. In a normal patient this is associated with minimal effects on the cardiovascular system due to the compensatory vasodilatation. But in a patient with diminished cardiac compliance,the increased venous return will not be well compensated(71).

The other common position used is the lateral position. In the lateral position it was noticed that the increases in preload and cardiac index and the decrease in systemic vascular resistance were greater in the right than in left lateral

position(72). In the head up position the effects on the respiratory system are minimal when compared to the more significant effects on the cardiovascular system. The cardiac output and the blood pressure fall due to reduction in venous return. These changes are more enhanced in hypovolemia or in patients with compromised cardiopulmonary reserve.

Neuromuscular injuries in laparoscopic procedures can be related to the stress of positioning or the direct surgical trauma. The nerve injures of the upper limbs can be caused by stretch, compression or ischemia due to positioning(73). Lower extremity nerve injuries were seen to occur due to both positioning and direct surgical trauma.

There are also cases reported who developed rhabdomyolysis post operatively as a complication of laparoscopic urological procedures. In one study the incidence has been found to be 0.67%. The risk factors reported were male sex, long operative times, the lateral decubitus position and high BMI (57).

In a study by Wolf et al conducted on 1651 laparoscopic urological procedures , it was seen that 46 neuromuscular injuries occurred in 45 patients with an incidence of 2.7%(8).

Table 4 Factors contributing to position related injury:

Patient related	Operative related
• Body mass index • Variant anatomy • Associated co morbidities- diabetes mellitus and peripheral vascular disease	• Position on the operating table • Duration of surgery

Table 5 The neuromuscular injuries noticed:

Neuromuscular injuries	Number of cases registered
Abdominal wall neuralgia	14
Extremity sensory deficit	12
Extremity motor deficit	8
Clinical rhabdomyolysis	6
Shoulder contusion	4
Back spasm	2
Total no of cases	45

POSITIONING FOR ROBOTIC ASSISTED UROLOGICAL SURGERY:

With the recent advances in surgery, robotics have come to play a role in performing a more controlled and accurate approach in urological procedures. Here to ensure safety the surgeons are faced with new surgical positioning.

The major differences in robotic surgery when compared to laparoscopic urological procedures are the use of a steeper trendelenburg position and the use of more equipment. Injury can occur due to accidental slippage or compression from the robotic arms. The surgeons view can be obscured due to the robotic arms coming on the way(9). During the split-leg positioning in robotic surgery an association between operative time and lower extremity injury has been seen. It was reported that a significant factor for development of post operative neuropathy was intraoperative time. It was also observed that the femoral nerve was at risk of injury in split- leg positioning (74). There is also a case report of a 57 year old man who underwent robot assisted laparoscopic prostatectomy and subsequently developed calf compartment syndrome which required fasciotomy(75). The study conducted by Mills et al reported an incidence of 6.6% of injuries related to positioning in robotic assisted urological procedures. Of these injuries 23% lasted for more than six months. The injuries were median

nerve palsy, hip adduction and flexion weakness, hand and foot numbness(9). It was concluded that the positioning related injuries in robotic urologic surgeries are often under recognized. Patients are risk must be recognized and counseled. The risk factors seen here were long operative times and patients with multiple co morbidities.

Table 6: Risk factors analyzed

Related to position	**Operative related**	**Patient related factors**	**Anaesthesia related**
• Positioning of upper limbs • Bean bag usage • Use of safety straps/tapes and their location • Trendelenburg tilt • Laterality of the operation	• Duration of surgery • In room time	• Body mass index • Neurological deficits • Diabetes mellitus • ASA class • Any vascular diseases • Gender	• IV fluids administered • The neuromuscular agent used • The frequency of positioning checks.

THE ADVANTAGES OF POSITIONING:

Positioning for surgery and anaesthesia is done in such a way as to facilitate the surgeon for the best surgical access, to reduce bleeding, to help in placing changes. After spinal anaesthesia the position maintained will influence the haemodynamics. When spinal anaesthesia is performed in lateral position with hyperbaric bupivacaine it causes greater cephalad spread and a delayed onset of hypotension(76). Hypotension can be avoided in elderly patients with low ejection fraction for hip surgeries when kept in lateral position for 15 minutes after spinal anaesthesia. It has been studied that critically ill patients are better off in prone position so as to improve oxygenation especially in those with acute lung injury(6). Likewise the lateral position is also seen to be beneficial especially in patients with unilateral lung infiltrates. This is done by positioning the affected lung in the non dependent position resulting in improved oxygenation(77). Head up position is also found to be beneficial for certain surgical procedures. A lithotomy position after spinal anaesthesia can help tackle the hypotension seen due to the peripheral pooling of blood.

DETECTION AND MANAGEMENT OF INJURIES:

To detect a position related injury and incident requires absolute vigilance by the anaesthesiologist as well the surgeon during and after surgery. Position checks can be done at periodic intervals during the surgery. It is recommended to check every thirty minutes for timely detection of malpositioning. Postoperatively also the patient should be followed up since nerve injuries can present later after few days(10).

When position related injury is detected, it is important to do a complete physical examination of the patient and document the injury, its appearance and the extent of the insult in the medical record. The need for further investigations and consultations should be considered. If needed treatment after neurological or opthalmological consultations can be done. Immediate interventions at times can be lifesaving in certain conditions. For example epidural hematoma if detected early can be surgically evacuated. A nerve injury can be evaluated by electromyography(EMG). It is useful to identify and pinpoint the lesion. By performing an EMG study it is possible to detect acute and chronic conditions affecting the nerve. Thus it can identify preexisting nerve insults. Neuropathies can be treated with analgesics, medicines used for neuropathic pain such as gabapentin, splinting,

physiotherapy etc. In Injuries that do not improve, sympathetic blockade,surgical neurolysis and nerve grafting can be considered.

MATERIALS AND METHODS

SETTING

This study was conducted in the operating rooms of the Department of Anaesthesiology, Christian Medical College (CMC) Vellore for a period of 6 months. The study was approved by the Institutional Review Board and Ethics Committee of Christian Medical College Vellore and was funded by the fluid research fund of CMC. The study was done among done among 291 consecutive consenting patients who fulfilled the inclusion criteria. They were enrolled in the study after obtaining written informed consent.

PARTICIPANTS

Inclusion criteria

1. All patients undergoing urological procedures in the operating rooms of CMCH, Vellore.
2. All ASA (American Society of Anaesthesiologists) 1, 2 , 3 ,4 and 5

ASA GRADING

1. Normal healthy individual

2. Mild to moderate systemic disease, not limiting function.

3. Severe systemic disease, some limitation of function.

4. Incapacitating systemic disease, constant threat to life.

5. Not expected to survive more than 24 hours with or without operation.

Exclusion criteria

Not consenting to be part of the study

METHODOLOGY

Protocol

All patients undergoing urological procedures under anaesthesia were recruited into the study after obtaining appropriate informed consent. The clinical history, co-morbidities (Diabetes, Hypertension, CRF, Hypothyroidism, peripheral vascular disease), preoperative neurological and vascular abnormalities were noted .The preoperative assessment was done by the principal investigator. All patients underwent the procedure as planned and the anaesthetic management (general anaesthesia /regional anaesthesia / conscious sedation/combined) was decided as per the concerned anesthetist's clinical judgment. The operative position was decided by the urologist and the anaesthetist. The nature of position, time taken to position, number of people involved, and the positioning aids were noted. Any adverse hemodynamic changes or incidents occurring during or after the positioning were noted (change in Mean Arterial Pressure/ heart

rate ± 20% of baseline in five minutes). The positioning aids used like prone pillows, axillary rolls, armrests/arm boards, saline bags, jelly rests were noted. At the end of the surgery the patient was re-examined for any injuries or incidents related to positioning. Any of the following injuries such as chemosis, conjunctival injury, corneal injury, blindness, peri orbital edema, extremity motor/sensory deficit, brachial plexus injuries, and gangrene and compartment syndrome was looked for. Any critical incidents during positioning such as endotracheal tube dislodgement and kinking, accidental extubation, dislodgement of venous and arterial lines and duration of loss of effective monitoring due to monitor dislodgement were observed.

Factors contributing to positional injury were categorized as patient related, procedure related, position related and anaesthesia related. The management of these injuries and their progress were followed up. The incidence of these injuries and incidents were analyzed and the risk factors associated were analyzed.

Calculation of Sample Size:

Based on the study by Wolf et al(8) the prevalence of positioning injuries was 2.5%. In order to estimate this, with the precision of 1%, with 95% CI then we need to study nearly 936 subjects. However, if the precision is 1.5% we need to study nearly 416 subjects. Therefore, we have decided to study nearly 900 subjects which would provide nearly 1 to 1.25% precision with 95% CI. However ,due to lack of sufficient time and cases, we have analysed the data at a sample size of 292 cases.

Formula:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

where n = sample size,
Z = Z statistic for a level of confidence,
P = expected prevalence or proportion (in proportion of one; if 20%, $P = 0.2$), and
d = precision (in proportion of one; if 5%, $d = 0.05$).

Statistical Analysis

The analysis was done using Stata version 10.

Descriptive statistics were done for variables like age, gender, ASA status, BMI, associated co morbidities, position of the patients, type of anaesthesia used.

Comparison of proportions were done between those who had position related injuries and incidents and those who did not.

Incidence of injuries is presented as percentage :

Number of reported injuries ÷ Total number of study population ×100

Incidence of incidents is presented as percentage:

Number of reported incidents÷ Total number of the study population×100

Pie charts and Bar diagrams were made using proportions of variables

RESULTS AND ANALYSIS

292 patients were enrolled in the study. In 291 patients the data was complete and included in the analysis. All the patients undergoing urological procedures in the operating rooms of CMCH, Vellore were enrolled . There were no exclusion criteria.

Table 1: Demographic details of the study participants

Descriptive (n = 291)	**Number (%)**
Age	
< 40 years	89 (30.5)
40 - 60 years	123 (42.1)
> 60 years	80 (27.4)
Sex	

Male	234 (80.1)
Female	57 (19.9)
BMI	
<18.5 **underweight**	31 (10.6)
18.5 - 24.9 **normal**	160 (54.8)
25.0 - 29.9 overweight	85 (29.5)
>=30.0 obese	15 (5.1)
ASA Status (n = 291)	
1	149 (51.4)
2	135 (46.2)
3	7 (2.4)

Demographic details of the study participants

Table 1 describes the demographic details of the patients under the study. Of the 291 patients enrolled ,the maximum numbers of patients were between the ages of 40-60 years(42%). The patients in other ranges of age(<40,>60) were almost equal in number(27 % and30%).

80% of the urological procedures were done in males.

Majority of the patients recruited(55%) were moderately nourished with a BMI between 18.5 and 29.9. Very few (5%) were in the obese category with a BMI of >/= 30. It was also observed that half of the patients were ASA 1 patients(51%).The ASA 3 patients were only 7(2.4%).

Table 2: Distribution of Associated co-morbidities of the study participants:

Descriptive (n = 291)	**Number (%)**
Comorbidities	
Yes	143 (49.0)
No	149 (51.0)
Type of co morbidity (n = 143)*	
DM	61 (42.7)
Hypertension	73 (51.1)
Hypothyroid	9 (6.3)
CRF	18 (12.6)
PVD	3 (2.1)
Others	30 (21.0)

* Percentage does not add up to hundred as patients may have reported more than one co-morbidity

Co-morbidities of the study participants

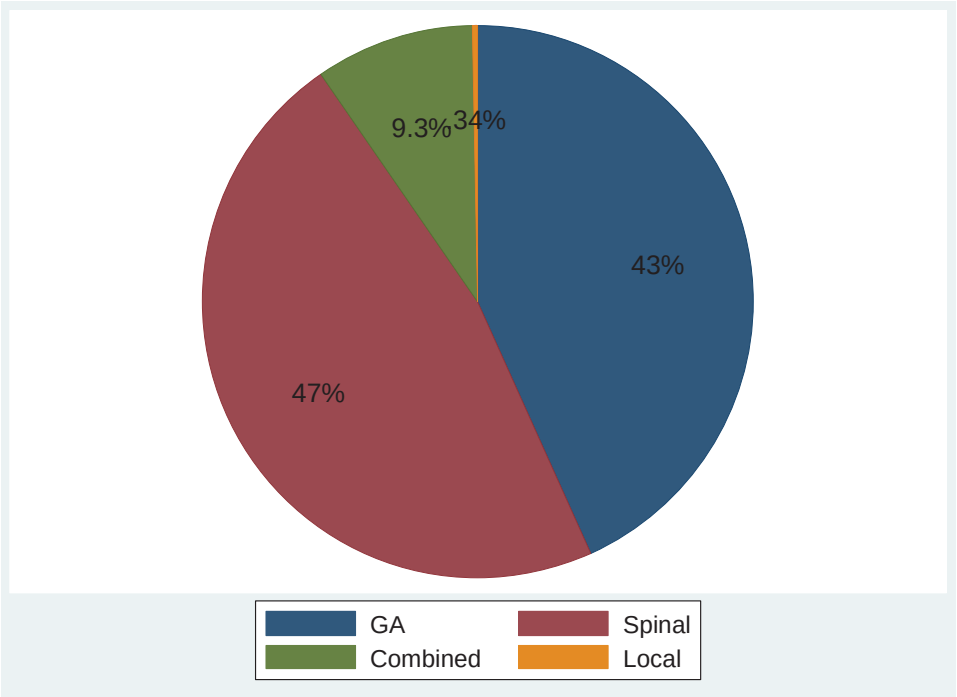
Table 2 above shows the distribution of associated co morbidities in the study population.

Almopst half of the population recruited into the study had associated co morbidities (50%). Among the 143 comorbid conditions noted almost half the patients(51%) had hypertension. Thus the percentage of patients who had hypertension from the total population recruited is 24%. The other major prevalent comorbidity was Diabetes Mellitus(42%) and of the total population, this accounted to about 20%.Peripheral vascular disease and hypothyroidism had the lowest incidence amongst the co morbidities mentioned (2% and6%).

Of the 291 patients analyzed only 2 patients had pre operative neurological deficit. One patient had post polio residual paralysis of the left leg. Another patient had right vocal cord paralysis.

Pre operative coagulation defects were found in only three patients from the whole study population. Two of them were found to have low platelet count while one patient had factor 5 Leiden deficiency.

Graph 1: Distribution of type of anaesthesia used for urological surgeries



Type of anaesthesia used for urological surgeries

Graph 1 illustrates the different types of anaesthesia used and their distribution.

On evaluation of the type of anaesthesia used , the majority of cases were done either by spinal or general anaesthesia .Regional anaesthetic procedures had a little higher incidence ,with 47% of the patients undergoing regional anaesthesia and 43% undergoing general anaesthesia.About 9% of the patients had combined regional and

general anaesthesia and less than a percent underwent local anaesthetic procedures.

Position of the patient for surgery

Table 3 and graph 2 shows the different positions involved and their distribution.

Concerning the position used for the urological procedure, the lithotomy position was used for a little more than half of the patients recruited(55 %). The other less predominant positions used were supine, lateral and prone(17.5%,13.8%and 9.3 respectively). The high lithotomy was used in only 1 % of cases.

Table 3: Position of the patient for surgery	
Position (n = 291)	**Percent**
Supine	17.5
Prone	9.3
Lateral	13.8
Lateral decubitus	3.2
Lithotomy	54.6
High lithotomy	1
Reverse trendelenburg	0.3
Head down tilt	0.3

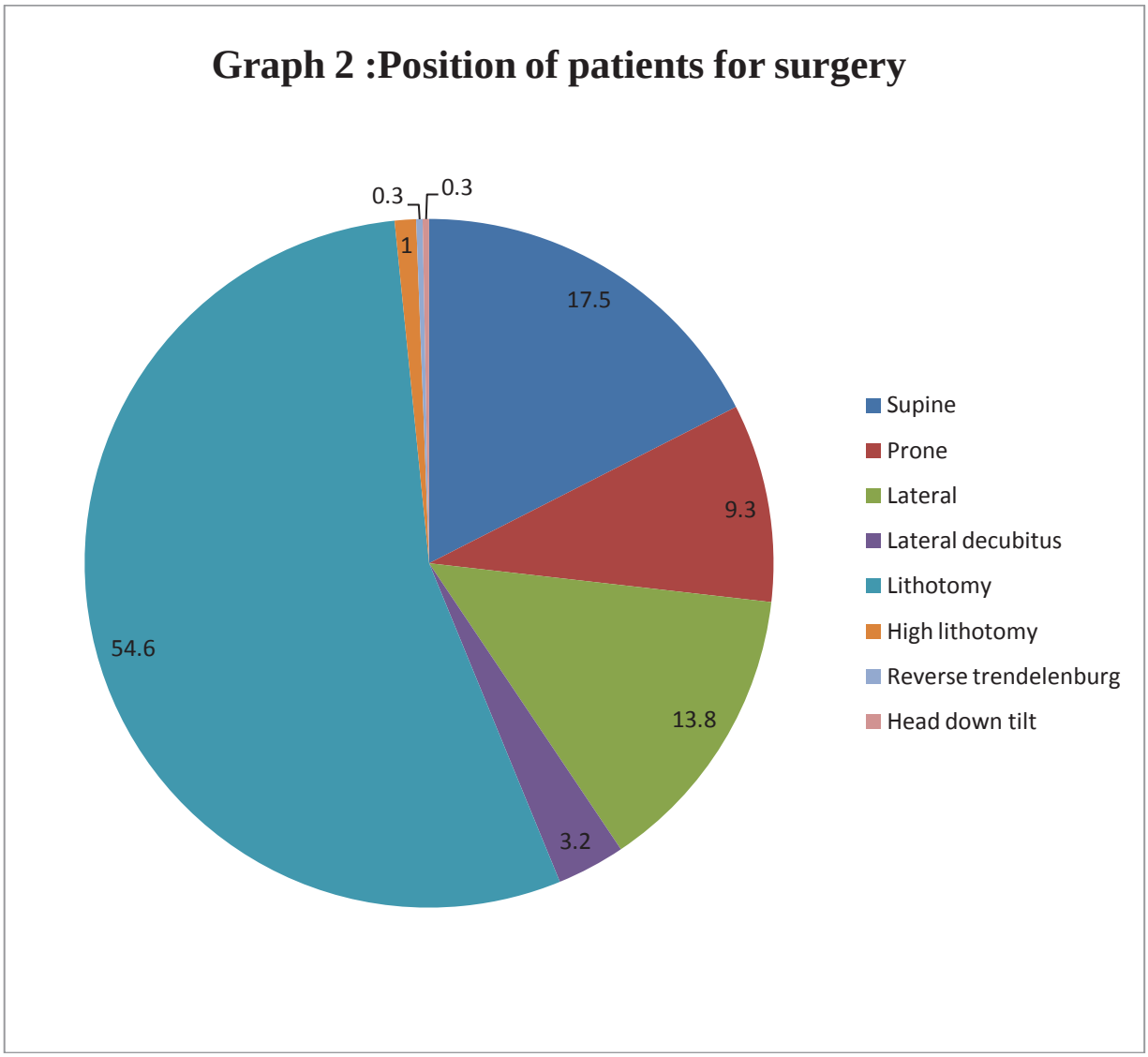


Table 4 Distribution of the types of urological procedures performed	
Type of urological procedure	Number (%)
Open	106 (36.4)
Endoscopic	154 (52.9)
Laparoscopic	30 (10.3)

Types of urological procedures performed

Table 4 above gives the proportion of open, endoscopic and laparoscopic procedures done in the study population. Endoscopic procedures formed a major chunk of the urological procedures(53%). Laparoscopic procedures accounted for only 10% of the procedures done. The rest of the procedures were open surgeries(36%).

Personnel and time taken for positioning

In 39 % of the urological procedures done, four personnel were available for positioning of the patient where as in another 25.5% ,three personnel were available. In a fewer percentage of procedures(13.8% and 11%) five and six personnel assisted in positioning respectively. Only two persons were available for 6% of the procedures and in a very small number of procedures(2%), 7-8 personnel helped out in positioning.

The time taken to position the patients for the urological procedure were less than or equal to five minutes in majority of the patients(87%). It was observed to be more than five minutes in the rest.

Table 5: Number of personnel for positioning and the time taken to position	
Personnel (n = 291)	**Number (%)**
2	18 (6.2)
3	74 (25.5)
4	113 (39.0)
5	40 (13.8)
6	32 (11.0)
7	6 (2.1)
8	7 (2.4)
Time taken to position	
≤5 minutes	254 (87.3)
>5 minutes	37 (12.7)

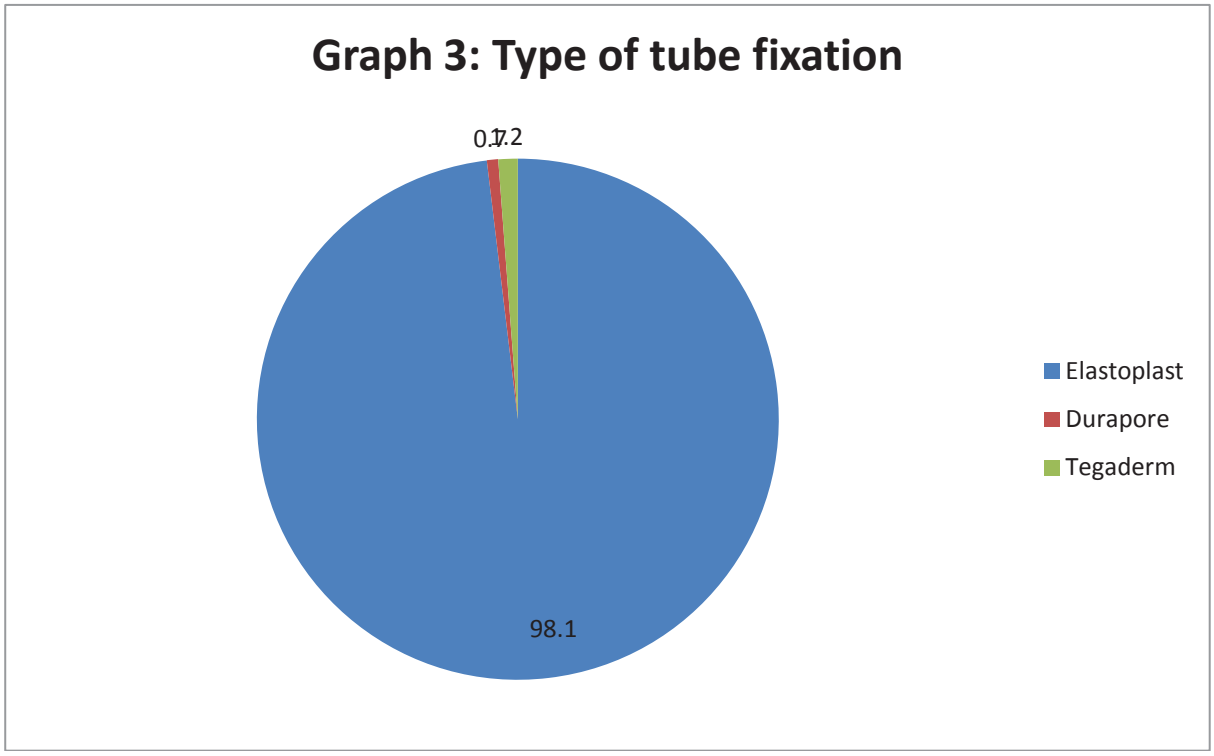
.

Table 6 : Distribution of type of tube fixation used	
Type used	**Percent**
Elastoplast	98.1
Durapore	0.7
Tegaderm	1.2

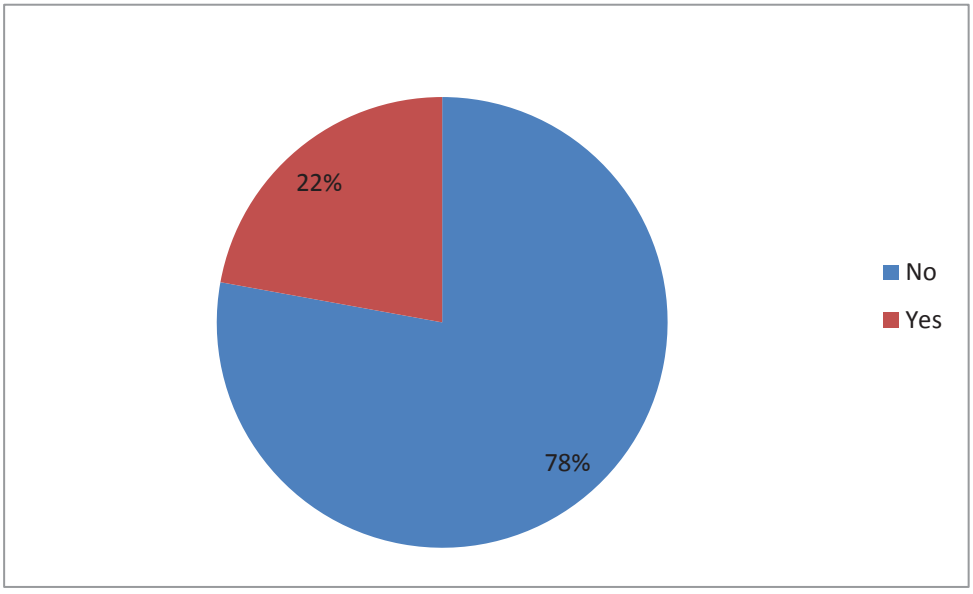
Endotracheal tube Adhesives and Bite Blocks

Table 6 and graph 5 gives an idea of types of tube fixation used and their distribution

In a major percentage(98%) of urological procedures done under general anaesthesia, the endotracheal tube / laryngeal mask airway was fixed with the help of the elastoplast. The durapore and the tegaderm were hardly used for tube fixation as it was not considered safe enough by most of the practicing anaesthetists.



Graph 4:Distribution Bite block used



The bite block was used for only 22 % of the procedures done under general anaesthesia.Of theses about 95% of the cases were in the prone position.This is done to prevent drooling of secretions in this position.

Positioning of the Upper Limb

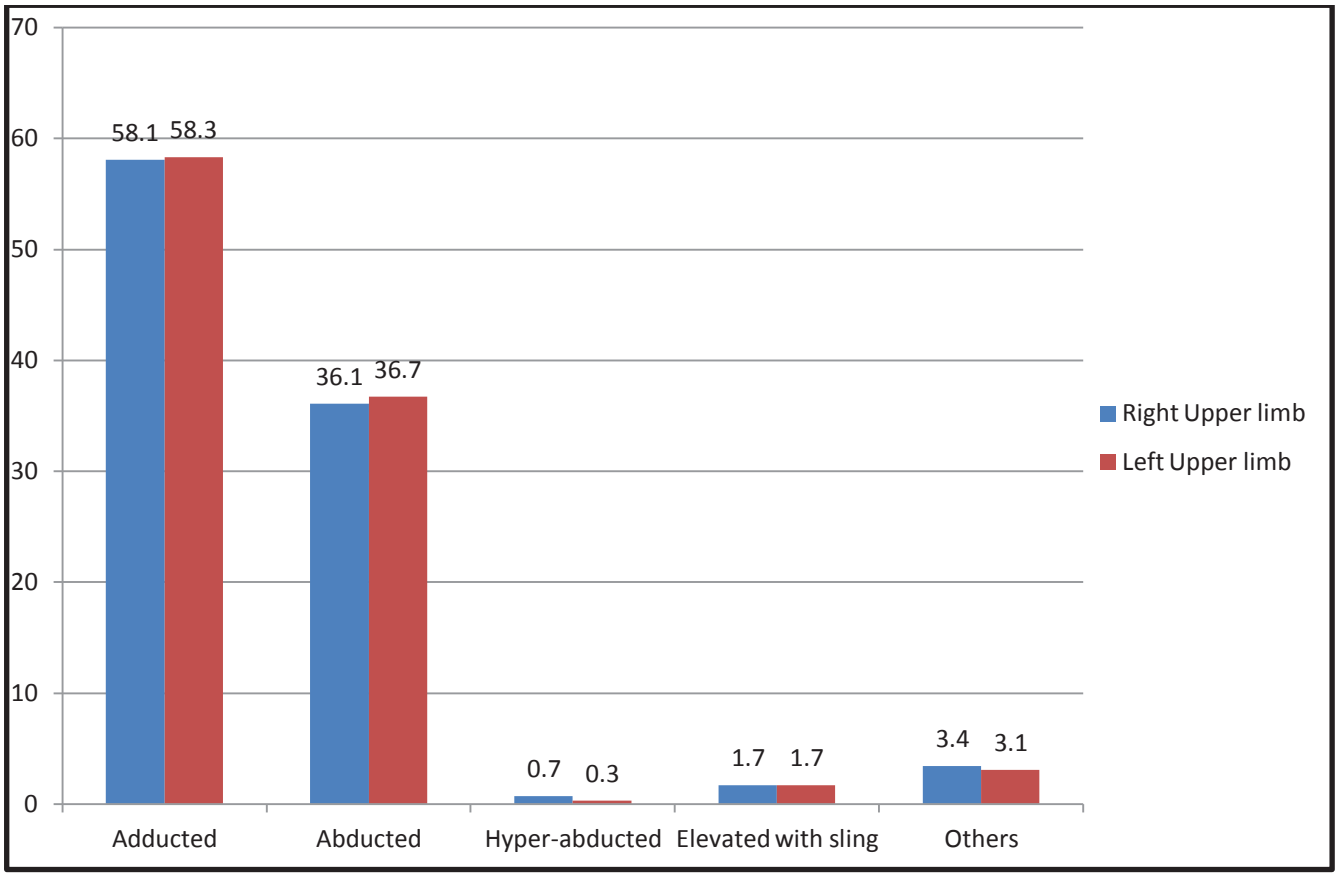
Table 7 and Graph 5 shows the positioning of the upper extremities and their distribution

Regarding the positioning of the upper extremities more than half of the patients(58%) were kept with both the right and left upper limbs adducted. whereas about 36% were placed with both the upper limbs in the abductedposition.

The hyper abducted position was observed only in 2 patients in the right upper limb and 1 patient in the left upper limb.However ,both these patients did not record any nerve injury

Table 7: Distribution of upper extremity positioning (n = 291)		
Positions	**Right Upper limb (no/%)**	**Left Upper limb (no/%)**
Adducted	169 (58.1)	169 (58.3)
Abducted	105 (36.1)	106 (36.7)
Hyper-abducted	2 (0.7)	1 (0.3)
Elevated with sling	5 (1.7)	5 (1.7)
Others	10 (3.4)	9 (3.1)

Graph 5 : Distribution of Upper extremity positioning



Positioning Aids

Other than the supine position , positioning aids were used in most of the procedures(70%). The most commonly used positioning aid was the leg stirrups (61%). The other frequently used positioning aids were the brachial

plexus gelly rolls and the saline bags(44%). Prone pillows, gels for the heel and gels for the knee were less commonly used (<15%).

Among the 291 urological procedures done warming devices were used in 80% of the procedures of which the the most common one was the Bair Hugger (98%). The fluid warmer was used in 36% of the procedures where warming devices were used. The hotline warmer, the inline fluid warmer was used only in a few procedures(5%) which were of longer duration.

Table 8: Positioning aids used

	Number (%)
Positioning aids used	
Yes	204 (70.1)
No	87 (29.9)
Head and eyes	
prone Pillow	27 (13.4)
None	175 (86.6)
Chest	

Pillow	38 (18.8)
None	164 (81.2)
Knee	
Gels	32 (15.8)
Saline bags	27 (13.3)
Others	12 (5.9)
None	132 (65.0)
Heel	
Gels	8 (4.0)
Saline bags	45 (22.3)
Others	7 (3.5)
None	142 (70.2)
Brachial plexus	
Pads	20 (9.9)

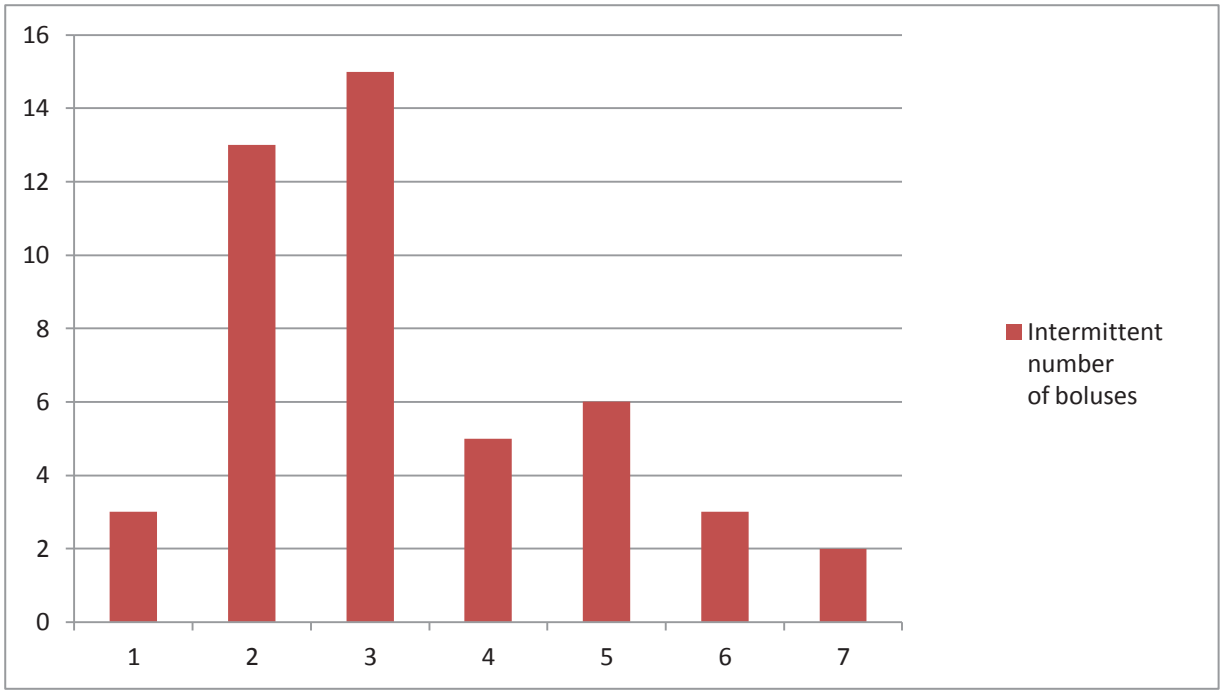
Rolls	44 (21.7)
Others	2 (1.0)
None	137 (67.6)
Other positioning aids (n = 157)	
Arm board	7 (4.5)
Arm stirrups	11 (7.0)
Leg stirrups	125 (79.6)

Other than the supine position ,positioning aids were used in most of the procedures(70%). The most commonly used positioning aid was the leg stirrups (61%). The other frequently used positioning aids were the brachial plexus gelly rolls and the saline bags(44%). Prone pillows, gels for the heel and gels for the knee were less commonly used (<15%).

Among the 291 urological procedures done warming devices were used in 80% of the procedures of which the the most common one was the Bair Hugger (98%). The fluid warmer was used in 36% of the procedures where

warming devices were used. The hotline warmer, the inline fluid warmer was used only in a few procedures(5%) which were of longer duration.

Graph 4:Distribution of the use of intermittent no of boluses during hypotension



Haemodynamic Changes during Positioning

Vasopressors like ephedrine, phenylephrine, nor adrenaline and adrenaline were used whenever there was short or longer episodes of hypotension. The

intermittent boluses of either ephedrine or phenylephrine were used in 16% of the patients who had short periods of hypotension and most of the patients had between 2 and 3 boluses(59.6%).It was observed that as a infusion for treatment of hypotension only noradrenaline was used in 5 patients(1.74%).

Intraoperative hypotension during the urological procedure was observed only in 12 adults in whom 7 of them had a significant drop of blood pressure of MAP less than 60mm Hg that lasted for more than 15 minutes.

Duration of Surgery

A greater proportion of the surgeries(68%) lasted between 1-4 hours and 24 % of the procedures lasted for less than an hour whereas 21% of the surgeries lasted for more than 4 hours.

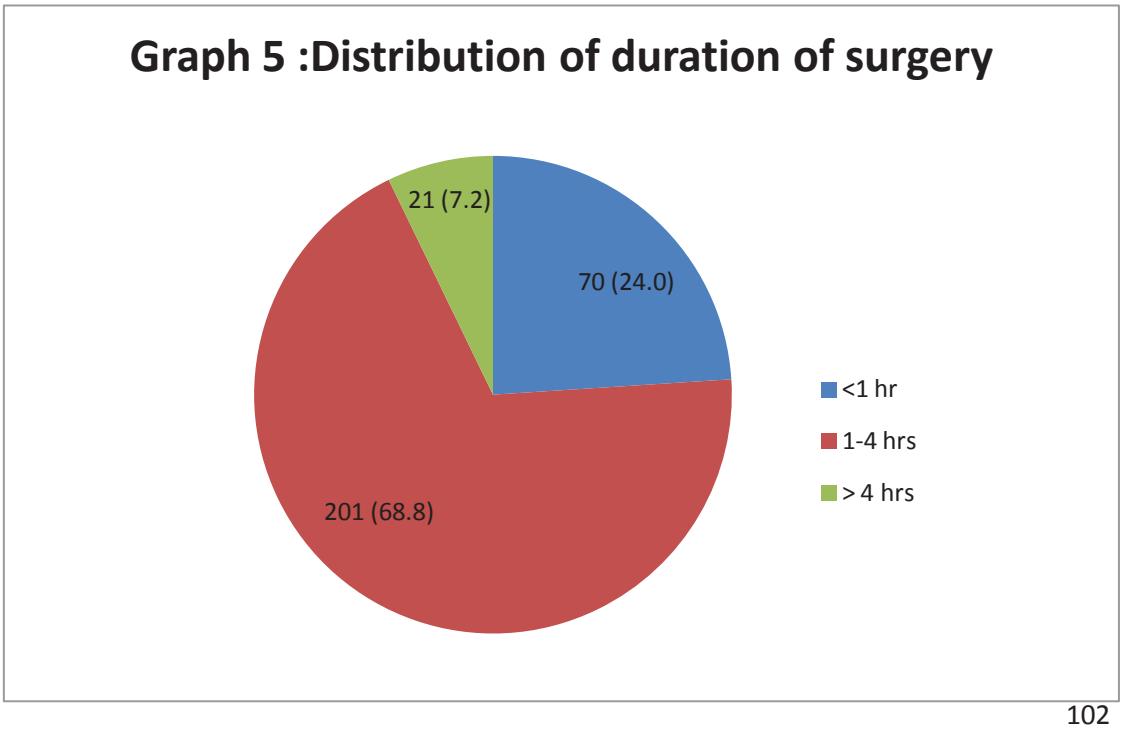


Table 9: Pre-operative parameters of study participants		
Parameter	**n**	**Mean (SD)**
Hemoglobin	290	12.7 (2.6)
Creatinine	285	1.1 (0.9)
Albumin	66	4.2 (0.7)
Heart rate	291	82.5 (39.3)
Blood pressure (systolic)	291	131.8 (52.0)
Blood pressure (diastolic)	291	76.8 (12.0)
sp02	291	99.9 (0.8)
Temperature (deg C)	136	35.9 (0.4)

Position-related injuries

Table 10 shows the incidence of position related injuries that has occurred in the study population. There were six injuries noted with an incidence of 2.1 %. Out of the 6 injuries 4 patients had eye injuries of which there were 2 cases of chemosis and 2 cases of redness in the eyes and 4 incidences of periorbital edema. Some of the patients had a combination of injuries in the eye

2 patients had injuries in the head and neck region of which both the injuries were lip edema.Both the cases were in the prone position

The other 2 patients who have had injuries occurred in the lower limbs of which one patient had skin edema of the leg and the other patient had sensory neuropathy on the left leg.

There were no injuries seen in the chest and abdominal area like skin peeling ,injury to breasts/ genitalia etc. No vascular injuries like loss of peripheral pulses and gangrene were also observed . Injuries to the brachial plexus and upper limbs like paresis, palsy, edema and compartment syndrome did not occur in any of the patients.

Table 10: Position-related injuries	
	Number (%)
Position injuries	
No	285 (97.9)
Yes	6 (2.1)
Eye *	**4/6**
Redness	2 (50.0)
Chemosis	2 (50.0)
Periorbital edema	4 (100.0)
Head and neck	**2/6**
Lip edema	2 (100.0)
Lower limbs	**2/6**
Skin edema	1 (50.0)
Nerve injury	1 (50.0)

** Percentage does not add to hundred as patients may have had more than one injury*

Position-related incidents

Table 11 describes the incidence of position related incidents that occurred out of the 291 patients. The incidence of position related incidents was reported to be 3.4% (seen in 10 patients) patients . In 5 of these patients

,hemodynamic changes were seen during positioning ,out of which 4 had hypotension and 1 had bradycardia.

Four incidents were seen related to the airway, from which in 2 patients there was endotracheal tube dislodgement, one patient had an incident of endotracheal tube kink and one patient sustained accidental extubation. One more incident was reported in a patient who sustained cautery burns in the sacral area. The position of the cautery plate was placed on the left leg.

There were no reported incidents of other adverse events which can occur due to positioning the patient for surgery. Other events which were observed were related to venous access like loss of arterial waveform and malfunction of venous access. There was also no reported incident of any loss of effective monitoring during the positioning. It is a common practice to have any one of the following monitor- Spo2/ECG/invasive Arterial Blood pressure ,for continuous monitoring of the vital signs before turning the patient.

Table 11: Position-related incidents	
Position-related incidents	**Number (%)**
No	281 (96.6)
Yes	10 (3.4)
Hemodynamic*	**5/10**
Hypotension	4 (80.0)
Bradycardia	1 (20.0)
Airway	**4/10**
Tube dislodgement	2 (50.0)
Kink	1 (25.0)
Accidental extubation	1 (25.0)
Cautery burns	**1/10**
Position of plate	left leg

* Percentage does not add to hundred as patients may have had more than one injury

Comparison of position of the patient with position related injuries

Table 12 refers to positions of patients who developed position related injuries. Half the injuries occurred in the prone position (3 out of 6). Two of the other injuries occurred in the lithotomy position and only one injury was reported in the supine position. No injuries were reported in the lateral , lateral decubitus and high lithotomy positions.

Table 12 :Comparison of position of the patient with position related injuries

Position of the patient for surgery	Position related injuries		Total
	No	Yes	
Supine	50	1	51
Prone	24	3	27
Lateral	40	0	40
Lateral decubitus	9	0	9
Lithotomy	157	2	159
High lithotomy	3	0	3
Reverse trendelenburg	1	0	1
Head down tilt	1	0	1
Total	285	6	291

Table 13: Comparison of position of the patient and position related incidents

Position of the patient for surgery	Position related incidents		Total
	No	Yes	
Supine	51	1	52
Prone	24	3	27
Lateral	36	4	40
Lateral decubitus	9	0	9
Lithotomy	156	2	158
High lithotomy	3	0	3
Reverse trendelenburg	1	0	1
Head down tilt	1	0	1
Total	281	10	291

Comparison of position of the patient and position related incidents

Table 13 shows the relative comparison of the position of the patient to the incidents that has occurred. Four events occurred in lateral position whereas three events took place prone position. As expected prone and lateral positions were associated with higher incidents and position related injuries. However, only two events were noticed in the lithotomy position and one in the supine position. It is significant to note although lithotomy position was used in majority of cases(158 times)that only 2 incidents occurred in the lithotomy position. There were no adverse events seen in high lithotomy, reverse trendelenburg and the lateral decubitus positions.

Table 14 : Comparison of position related injuries to the type of anaesthesia used

Type of anaesthesia used	Position related injuries		Total
	No	Yes	
GA	122	4	126
Spinal	136	1	137
Combined	26	1	27
Local	1	0	1
Total	285	6	291

Comparison of position related injuries to the type of anaesthesia used

Table 14 shows the relative comparison of the position related injuries to the type of anaesthesia used. Of the total of 126 patients who underwent general anaesthesia,Four injuries were noted,whereas only one injury was noted among the137 patients who received spinal anaesthesia .Of the 27 patients who received conbined general and regional anaesthesia only one patient had an injury.

Comparison of position related incidents and the type of anaesthesia used

Table 15: comparison of position related incidents to the type of anaesthesia used

Type of anaesthesia used	Position related incidents		Total
	No	Yes	
GA	118	9	127
Spinal	137	0	137
Combined	25	1	26
Local	1	0	1
Total	281	10	291

Table 15 shows the comparison of the position related incidents to the type of anaesthesia used. Out of the 10 incidents reported 9 were seen when the patients were under general anaesthesia and only one occurred in a patient under combined anaesthesia . Patients who had spinal anaesthesia had no adverse events related to positioning

Comparison of the duration of surgery with position related injuries and the position of the patient

The table 16 given below is a relative comparison of the duration of surgery with the position related injuries and the position of the patients. The surgeries were divided into < 1 hour,1-4 hours and > 4 hours. It was revealed that most of the surgeries were done in the duration between 1- 4 hours(201) out of which three injuries occurred and all the three injuries were reported in the prone position.

The other three injuries occurred in surgeries lasting for > 4 hours(out of only 20 surgeries in this category) which is quite significant. In this 2 injuries occurred in lithotomy position and one in supine.

There were no injuries reported in surgeries performed in less than 1 hour. Here 51 procedures were in lithotomy and 19 in supine position.

Table 16

Comparison of the duration of surgery with position related injuries and the position of the patient									
Position of the patient for surgery	**<1 hr**			**1- 4 hrs**			**> 4 hrs**		
	Position related injuries		Total	Position related injuries		Total	Position related injuries		Total
	No	Yes		No	Yes		No	Yes	
Supine	19	0	19	22	0	22	9	1	10
Prone	0	0	0	24	3	27	0	0	0
Lateral	0	0	0	38	0	38	2	0	2
Lateral decubitus	0	0	0	8	0	8	1	0	1
Lithotomy	51	0	51	102	0	102	4	2	6
High lithotomy	0	0	0	2	0	2	1	0	1
Reverse trendelenburg	0	0	0	1	0	1	0	0	0
Head down tilt	0	0	0	1	0	1	0	0	0
Total	70	0	70	198	3	201	17	3	20

Table 17 given below gives a relative comparison of the duration of surgery with the position related incidents and position of the patient.

9 incidents were reported in the surgeries lasting between 1-4 hours of which 4 events took place in lateral position, three in prone position and one in lithotomy position.The remaining one event was also seen in the lithotomy position but the surgery lasted for < 1 hour . No adverse events were reported in the urological procedures lasting for more than 4 hours

Duration of surgery with position related incidents and the position of the patient

Table17 : Comparison of the duration of surgery with position related incidents and the position of the patient

Position of the patient for surgery	**<1 hr**			**1- 4 hrs**			**> 4 hrs**		
	Position related incidents		Total	Position related incidents		Total	Position related incidents		Total
	No	Yes		No	Yes		No	Yes	
Supine	19	0	19	21	1	22	10	0	10
Prone	0	0	0	24	3	27	0	0	0
Lateral	0	0	0	34	4	38	2	0	2
Lateral decubitus	0	0	0	8	0	8	1	0	1
Lithotomy	50	1	51	101	1	102	5	0	5
High lithotomy	0	0	0	2	0	2	1	0	1
Reverse trendelenburg	0	0	0	1	0	1	0	0	0
Head down tilt	0	0	0	1	0	1	0	0	0
Total	69	1	70	192	9	201	19	0	19

Comparison of the type of anaesthesia , duration of surgery and position related injury

Table 18 gives a relative comparison of the type of anaesthesia used with the duration of surgery and the position related injury.

Out of the procedures lasting between 1-4 hours three patients sustained injuries under general anaesthesia which was administered to 102 patients. The patients who had spinal and combined anaesthesia in this category were injury free.

The other three injuries were noted in the surgeries which lasted for > 4 hours of which the injuries were shared equally by three types of anaesthesia administered (GA,spinal and combined) which is quite significant considering the fact that only 20 surgeries lasted for >4 hours.

Of the 70 procedures done in less than 1 hour, majority of them(55) were done under spinal but none of the patients suffered injuries in any of the positions in this category.

Table 18 :Comparison of the type of anaesthesia used with duration of surgery and position related injury

Type of anaesthesia used	<1 hr			1- 4 hrs			> 4 hrs		
	Position related injury		Total	Position related injury		Total	Position related injury		Total
	No	Yes		No	Yes		No	Yes	
GA	14	0	14	99	3	102	9	1	10
Spinal	55	0	55	80	0	80	1	1	2
Combined	0	0	0	19	0	19	7	1	8
Local	1	0	1	0	0	0	0	0	0
Total	70	0	70	198	3	201	17	3	20

Type of anaesthesia , duration of surgery and the position related incidents

Table 19 given below is a relative comparison of the type of anaesthesia used with the duration of surgery and the position related incidents.

As seen position related incidents have occurred most in The surgeries performed in 1-4 hours duration in which 8 events happened when general anesthesia was administered and one incident was seen during combined anaesthesia.

The remaining one incident was seen in a surgery performed within 1 hour for which general anaesthesia was administered. It was noted that in this category 14 surgeries were done under general anaesthesia.

Of the 19 procedures which lasted for > 4 hours, the majority of them were general anaesthesia and combined (10 and 7) of which there were no incidents related to position.

Table19 :Comparison of the type of anaesthesia used with the duration of surgery and the position related incidents

Type of anaesthesia used	**<1 hr**			**1- 4 hrs**			**> 4 hrs**		
	Position related incidents		Total	Position related incidents		Total	Position related incidents		Total
	No	Yes		No	Yes		No	Yes	
GA	13	1	14	94	8	102	10	0	10
Spinal	55	0	55	80	0	80	2	0	2
Combined	0	0	0	18	1	19	7	0	7
Local	1	0	1	0	0	0	0	0	0
Total	69	1	70	192	9	201	19	0	19

Body Mass Index(BMI) and Position related Injuries and Incidents

Table 20 compares BMI with position related injuries . Here 3 injuries were seen normally built individuals out of the 160 in the study population(1.8%). Two injuries occurred in the underweight individuals out of the 31 underweight in the study population which may be of significance (6%). Only one occurred in the overweight and none in the obese individuals.

Table 20: Comparison of BMI with position related injuries			
BMI	Position related injuries		Total
	No	Yes	
Under weight	29	2	31
Normal	157	3	160
overweight	84	1	85
Obese	15	0	15
Total	285	6	291

4

Table 21 shows the comparison between BMI and position related incidents. Here out of the 10 incidents that has occurred, 4 incidents took place in both the normal built and the overweight individuals out of the 160 normal built and the

85 overweight of the study population. Two adverse events occurred in the underweight of the 31 underweight patients in the study. Interestingly the obese category did not suffer any adverse events.

Table 21: comparison between BMI and Position related incidents

BMI	Position related incidents		Total
	No	Yes	
Under weight	29	2	31
Normal	156	4	160
overweight	81	4	85
Obese	15	0	15
Total	281	10	291

DISCUSSION

Optimal positioning is a need of the surgeon for the best surgical access. At the same time care must be taken to minimize the risk of injury to the patient and avoid the adverse outcomes that can occur as a result of positioning. Each position carries some risk and this risk is more in the anaesthetized patients who are not aware nor can express discomfort on compromised positions. Urological procedures involve different kinds of positions as these surgeries require access to the urogenital organs, the pelvis, kidneys and the retro peritoneum. In order to access these structures various surgical approaches like open ,laparoscopic ,endoscopic and robotic are practiced . In urological procedures the common positions used are the supine, lithotomy, high lithotomy ,lateral, lateral decubitus, kidney bench and jackknife . Many of these positions are modified with a vertical tilt (trendelenburg or reverse trendelenburg).

According to American society of anaesthesiologists closed claims project, since 1990, 10 nerve injuries (7%) were directly related to patient positioning in 143 claims reviewed. The incidence of nerve injury in open general surgery is 0.14% in a study done by Parks et al(16). In another study done on open retropubic radical prostatectomy(78), the incidence was seen to be only 0.3 %. In our study only one patient sustained nerve injury

from the whole study population. It was an isolated case of sensory neuropathy which occurred in the lateral part of the left leg. The incidence calculated is 0.3 % which is similar to the study done on open retropubic radical prostatectomy.

In a study done by James T Mills et al on positioning injuries occurring in patients undergoing robotic assisted urological surgery an incidence of 6.6 % of the injuries were reported (9).

Wolf et al conducted a study and calculated an incidence of 2.7% neuromuscular injuries in patients who underwent laparoscopic urological procedures (8). Our study did not report any neuromuscular injury to patients in laparoscopic procedure, but the incidence seen for position related injuries in all the urological procedures is about 2.1 % which is slightly less than the above study. Injuries reported were redness of eyes ,chemosis, periorbital edema, lip edema, lower limb edema and sensory neuropraxia.This is probably due to the smaller sample size of the study.

In our study the incidence of position related incidents was also observed. The incidence was seen to be 3.4 % . The reported incidents were hypotension, bradycardia, endotracheal/ LMA tube dislodgement ,tube kink, accidental extubation and cautery burns. The most frequent one was hypotension. Airway incidents were also significant. An incident that could

have been potentially serious was a cautery burn which was seen in the sacral area even though the cautery plate was placed on the left leg. This was noticed the day after the surgery was performed. Fortunately for the patient it healed well and there was no significant morbidity. The other events like hemodynamic changes, airway issues like tube kink, dislodgement and accidental extubation did not pose much serious problems as they were managed well.

On evaluation of the type of anaesthesia used it was seen that majority of cases were done by either spinal or general anaesthesia. But more injuries occurred in patients who had general anaesthesia (3.1%) compared to spinal anaesthesia (0.72%). 1 injury occurred in one patient who had combined (both regional and general) anaesthesia which is quite significant considering the fact that only 22 patients had combined anaesthesia.

The relative comparison of incidents occurring during positioning also depicted a similar picture incidents occurring predominantly in general anaesthesia (7%) but none occurred in cases undergoing spinal anaesthesia. One incident occurred when combined anaesthesia was administered which may be of significance since only 26 surgeries were performed under combined anaesthesia(3.84%). This single incident reported is a case of cautery burns which was seen in a 40 year old lady who underwent left open

radical nephrectomy under combined general and spinal anaesthesia in the supine position.

In our study ,table 10 shows the breakup of the position related injuries based on the position of the patient. Out of the 6 injuries that occurred 3 has been noticed in the prone position. The total number of surgeries done in prone position was 27. So the incidence of injures in prone position amounts to 11 %. The injuries seen were incidences of redness to the eyes , chemosis and periorbital edema and lip edema. All three patients underwent percutaneous nephrolithotomy in prone position.None of these injutries required any active intervwention and there was no loss of visual acquity .

In our study on comparing the position of the patient to the position related incidents, it was seen that among the 10 incidents, 3 events took place when the patients was turned prone and 4 events took place in the lateral position. In the prone position , all the three events occurred when the patients underwent percutaneous nephrolithotomy .The events were endotracheal tube dislodgement ,tube kink and hypotension. The patient who sustained tube dislodgement had to be re intubated.

Another 4 incidents happened in the lateral position and the main issue was hypotension which occurred in three patients and bradycardia in one patient. All patients here were given general anaesthesia. The patients did not suffer

any consequences from these issues as they were seen only for a few minutes and were well managed.

Two incidents in which both were airway issues (tube dislodgement and accidental extubation) took place in the lithotomy position. It is interesting to note that both the patients were administered general anaesthesia. The surgeries done were TURP and meatoplasty. The two patients were re intubated and did not suffer any morbidity.

In the supine position an isolated incident of hypotension was reported for a patient who underwent open nephrectomy.

In our study on comparing the duration of surgery with position related injuries and position of the patients ,it was seen patients who had surgeries of short duration were safe from injuries and most of them were done in lithotomy position. Both the moderate duration(1-4 hours) and longer duration surgeries(>4 hours) shared the injuries equally(3 each). But it is significant to note that only 20 surgeries of longer duration were performed out of which 3 three injuries occurred(15%) of which 2 occurred in lithotomy positions and one in supine.

In our study on comparison with the 10 incidents and duration of surgery with position of patients except for one incident all were reported in surgeries of moderate duration. The isolated incident took place in a short

surgery in lithotomy position. Among the 9 incidents ,4 occurred in lateral position,3 in supine and 1 in lithotomy. No events were noticed in surgeries of long duration.

In our study comparing the type of anaesthesia used on the duration of surgery and injuries both the moderate duration surgeries and the long duration surgeries shared 3 injuries each. But the 3 injuries took place in patients who had general anaesthesia in the moderate duration surgery category and in the long duration category the GA, spinal and the combined approach shared 1 injury each.

When comparing the incidents in this study nine occurred in the moderate duration category of which 8 patients underwent GA and 1 underwent combined anaesthesia. One incident took place in the short duration category where the patient was administered general anaesthesia.

In our study the BMI was also compared to the injuries and incidents related to position. Considering the injuries two were seen in the underweight population which may be of significance (6%). Three were noticed in the normally built population(1.8%). On analyzing the incidents in comparison with the BMI the maximum number of incidents occurred among the normal built and the overweight sharing 4 each (2.5% and 4.7%). Two incidents happened in the underweight out of the 31 procedures (6.4%) which may be

of significance. It is interesting to note that the obese category did not suffer any incidents.

LIMITATIONS

Due to time constraints ,our study could recruit only 291 patients and the incidence of injuries and incidents are very few to show any statistically significant values. We are continuing the study to achieve a larger sample size , so that the associations of position related injuries with certain procedures and comorbidities may be better described in an Indian Setting.

CONCLUSION

In this study our aim was to know the incidence of position related injuries and incidents in urological procedures under anaesthesia. We have observed that the incidence of injuries related to position is 2.1 % which is less than previous studies done on urological procedures. Most of the injuries reported were in the eyes and head like chemosis, periorbital edema lip edema. The only nerve injury which occurred was sensory neuropraxia where the patient complained of numbness in the lateral aspect of the left leg observed post operatively. The patient had undergone redo anastomotic

urethroplasty under general anaesthesia. This was due to the long duration of procedure (> than 6 hours) in the lithotomy position.

We have also observed the incidence of incidents related to positioning in urological procedures and found the incidence is about 3.4%.The reported incidents were hypotension, bradycardia, endotracheal/ LMA tube dislodgement ,tube kink, accidental extubation and cautery burns. The most frequent one was hypotension. Airway issues were also significant. The significant incident which could have been avoided was the cautery burns which occurred in a patient who underwent left open radical nephrectomy under combined general and epidural anaesthesia. The patient recovered well from the insult and did not report any morbidity.

In our study it was found that more injuries and incidents happened when general anaesthesia was administered. Moreover, patients undergoing procedures in the in prone position were more vulnerable to injuries(11%) and position related incidents also(11%). It is interesting to note that all the injuries and events in prone occurred in patients undergoing PCNL ((Percutaneous nephro lithotomy). Hence, more care and precaution need to be taken when a patient undergoes this procedure in prone.

In this study, it was obvious that procedures of short duration were relatively safe from position related injuries. Longer duration surgeries were more

susceptible to injuries and incidents due to positioning. Hence, care must be taken when positioning a patient for longer procedures and all standard precautions must be undertaken.

We observed that the patients who had a low BMI were more at risk for injuries and incidents due to positioning than those in the normal or high BMI. This is probably because since obesity is a known risk factor for position related injuries, more precautions were taken to avoidposition relarted incidents. We would like to conclude that the thin patient is also at a higher risk of position related injury.

In conclusion, it must be stressed that positioning related injuries and incidents under anaesthesia can go unrecognized and utmost care must be taken to avoid the occurrence of these injuries and incidents. These are more common in patients undergoing long procedures under general anaesthesia and those undergoing PCNL in the prone position. Hence it is important to counsel patients undergoing surgeries about the rare possibility of positioning injuries and incidents especially in long surgeries. Although the incidence of position related injury is less compared to the Western population, continuiung the study to achieve a larger sample size which was originally intended would throw more light on the incidence of position related injury and incidents, especially in the Indian subcontinent.

ANNEXURES

1.

PATIENT PROFORMA Elective / Emergency

Incidence of position related injuries and incidents in patients undergoing urological procedures.

Serial No: OR: 4, 5, 5A, 9, daycare, others Date:

Name: Age: Sex: Hospital No:

Weight: Height: BMI: ASA Status:
Diagnosis:
Surgery:
Co-Morbidity: DM/ Hypertension/ Hypothyroid/ CRF/ Peripheral Vascular Disease/Others

H/O Smoking: +/- Alcohol intake: +/-

Preoperative Neurological Deficit: Yes/No
If yes, mention:

Preoperative coagulation defects: Yes/ No. If yes, Mention:

Preoperative Investigation: Hb------/ Creatinine------/ Albumin---------
Type of Anaesthesia used: GA/Spinal/Combined/Conscious sedation/Local/others

Position: Supine/ Prone/ Lateral/ Lateral decubitus/ Lithotomy/High Lithotomy
Head up tilt/ Reverse trendelenburg/ Trendelenburg /Head down tilt/ others

Time taken to position: (In minutes) Time of positioning:

No. of Personnel available for positioning:

Tube fixation: Elastoplast / Durapore / Tegaderm

Bite block: Y/N

NG tube: Y/N
Position of upper extremity:
Right: Adducted / Abducted / Hyper abducted / Elevated with a sling / Other
Left: Adducted / Abducted / Hyper abducted / Elevated with a sling / Other

Positioning aids used:

Head & Eyes- Prone pillow
Chest- 4 post frame/ pillows
Knee- gels/ saline bags/ others
Heel- gels/ saline bags/ others
Brachial plexus- Pads/ Rolls/ others
Other positioning aids utilized:

Warming device used: Bair hugger/Hotline warmer/none/fluid warmer
Duration of Surgery:
Baseline HR: BP: SPO_2: Temperature:

Use of Vasopressors: Infusion/ Intermittent (no. of Boluses)
Infusion- Noradrenaline/ Adrenaline/ Others

Intraoperative Hypotension: Yes/ No
MAP < 60 mm Hg adults for > 15 minutes
MAP < 45 mm Hg children for > 15 minutes

Amount of fluids used:
Crystalloids-
Colloids-
Blood-
Blood Products-

Total blood loss: Total Urine output:
Position related injuries **Yes/No. If yes,**

Eyes: Redness/ Chemosis/ Corneal injury/ Conjunctival injury/ Decrease in visual acuity/ Blindness/ Periorbital edema

Head & Neck: Skin peeling/ soft tissue injury/ ear/ nose injuries/ Lip Edema./ Chin Necrosis/ Lip Edema/ Others

Chest & Abdomen: Skin peeling/ bruising/ soft tissue injury/ Injury to Breasts / Genitalia

Lower Limbs: Skin edema and soft tissue injury/ Compartment syndrome/ Nerve injury/DVT

Vascular: Loss of peripheral pulses/ gangrene

Brachial plexus & Upper limbs: Palsy/ Paresis/ Edema/ Compartment syndrome

Others:
Position Related incidents **Yes/No. if yes,**
Hemodynamic- Hypotension/ Bradycardia,

Airway- Tube dislodgement/ Kink/Accidental Extubation

Position of cautery plate **Cautery burns +/-**

Venous access- Loss of arterial waveform/ Malfunction of venous access

Loss of effective monitoring (Duration) –

Hypothermia (<35`C) +/-

Others / Untoward Incidents/Specific issues which need to be mentioned

2. Informed Consent Form for Subjects

Study Title: Incidence of position related injuries and incidents in patients undergoing urological procedures under anaesthesia.

Study Number:_____

Subject's Initials: _____

Subject's Name: _____

Date of Birth / Age: _____

(Subject)

(i) I confirm that I have read and understood the information sheet dated _____ for the above study and have had the opportunity to ask questions. [ ]

(ii) I understand that my participation in the study is voluntary and that I amfree to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. [ ]

(iii) I understand that the primary investigator, others working on the project, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or publishedin any journal. [ ]

(iv) I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).[ ]

(v) I agree to take part in the above study.[ ]

Signature (or Thumb impression) of the Subject/Legally Acceptable

Date: _____/_____/_____

Signatory's Name: _____Signature:

Or

Representative: _____

Date: _____/_____/_____

Signatory's Name: _____

Signature of the Investigator: _____

Date: _____/_____/_____

Study Investigator's Name: _____

Signature or thumb impression of the Witness: _____

Date: _____/_____/_____

Name & Address of the Witness: _____

_____

Christian Medical College, Vellore
Tamil Nadu, India

3. INFORMATION SHEET

This information sheet is for patients planned for urological procedures under anaesthesia, who would like to participate in a study, to assess the **incidence of position related injuries and incidents in patients undergoing urological procedures**.

Name of Principal Investigator : Dr Sunimal Bhaggien
Phone no: 9003516845, 04162282105
Name of Sponsors : IRB fluid grant
Name of Project : Incidence of position related injuries and incidents in patients undergoing urological procedures under anaesthesia.

You are requested to participate in a study to assess the incidence of position related injuries and incidents in patients undergoing urological procedures. Since the urinary and genital organs are placed deep inside the body, urological procedures are complex and involve different positions such as supine (lying flat on your back), head down, head up, legs up, or lying on one side (lateral) and lying prone (lying flat on your tummy). To assist in positioning, we use various positioning aids such as cotton pad, leg and knee supports etc. The long duration of the procedures, associated with the complex position makes you susceptible for position related injuries such as abrasions, skin peeling, numbness, eye swelling, weakness of legs/hands etc. These complications can happen to anybody undergoing these procedures, but some patients are at higher risk of developing these than the others. Some of the known risk factors are Diabetes, Renal failure, thin patients and those with diseases of the blood vessels.

This is an observational study, planned to be conducted on all patients. Routine pre-anaesthetic check up will be done and routine measures to avoid position related injury will be taken. You will be monitored both during and after surgery to look for any position related injury. If there is any injury, your doctor will provide the appropriate management. You will be followed up to assess the outcome following the treatment.

Confidentiality: This study is strictly confidential; the information will not be seen by others. No one will have access to the forms except the project team. All the information about you that will be collected from the research will be put away and no-one but the researchers will be able to see it.

You can contact the principal investigator for any queries regarding the study

Subject's responsibilities on participation:

Routine preoperative pre-anaesthetic check up and standard precautions for postioning will be undertaken. Intraoperative monitoring will be done. Postoperatively patient will be followed up to look for any position related injuries. The participation in this project is voluntary and the subject can withdraw from the study at any time. The refusal to participate will not involve any penalty or loss of benefits to which the subject is otherwise entitled.

The principal investigator has the right to decide on the termination of the subject's participation depending upon foreseeable circumstances without the subject's consent.

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serialno	or	date	age	sex	weight	height	bmi	asa	diag	surgery	type	comorbid	diabetes	htn	hypothy	crf	pvd	others	smoking	alcohol	pond	pondy	pocd	pocdy	hb	creat	albumin	anaes	position	ttp	persons	tubefix	biteblock	ng	upr	upl	aids	headeyes	chest	knee	heel	bp	otherpa	warming	bair	fluid
1	2	17/06/2014	41	1	80	165	29.38	2	lt lower po	lap lt radic		1	1	0	1	0	0	0	0	0	0	0	0	0	13	1.23	4.6	1	4	10	5	1	1	1	2	2	1	0	2	2	2	2	rt arm stirr	1	1	0
2	3	18/06/2014	72	1	61	156	25.07	2	bph	turp		1	1	1	1	0	0	0	0	0	0	0	0	0	14.1	0.76	3.7	2	5	5	4		0	0	2	2	1	0	0	3	0	0		1	1	0
3	5	18/06/2014	58	1	71	166	25.77	1	rcc lt kidne	lt lap neph		1	1	0	0	0	0	0	1	0	0	0	1	decre plat	9.5	1.23	4.2	1	3	10	5		0	1	2	2	1	0	0	2	2	2	stirrup for	1	1	0
4	3	18/06/2014	63	1	87	173	29.07	1	bph	turp		1	0							0	0	0	0		12.9	0.97		2	5	1	3		0	0	1	1	1	0	0	0	0	0	0	leg stirrup	1	1	0
5	3	18/06/2014	57	1	75	165	27.55	1	bph	turp		1	0							1	0	0	0		13.6	0.8		2	5	1	3		0	0	1	1	1	0	0	0	0	0	0	leg stirrup	1	1	0
6	1	19/06/2014	41	1	79	178	24.93	2	bilat renal	lt pcnl		1	1	1	0	0	0	0	0	1	0	0	0		14.5	0.8	4.9	1	2	2	5		0	0	2	2	1	1	2	3	3	2		1	1	1
7	3	19/06/2014	32	1	76	188	21.5	1	stricture u	substitutio		1	0							0	0	0	0		13	0.7		1	5	2	4		0	0	1	1	1	0	0	1	0	1	leg stirrup	1	1	0
8	5	19/06/2014	31	1	62	165	22.77	1	non func lt	lt lap neph		1	0							0	0	0	0		16	1.19		1	3	1	6	1	1	1	1	2	2	1	0	0	2	0	1	stirrup lt h	1	1	1
9	5	20/06/2014	35	1	72	173	24.06	2	multiple lt	lt pcnl		1	1	0	0	0	1	0	0	0	0	0	0		0	0	0	1	2	10	5	1	1	0	2	2	1	1	2	1	0	0		1	1	1
10	3	20/06/2014	25	1	48	162	18.29	1	lt renal cac	lt lap proc		1	0							0	0	0	0		13.6	0.83		1	3	3	4	1	1	1	2	2	1	0	0	2	3	2		1	1	1
11	2	25/06/2014	26	2	46	165	16.9	1	non func k	rt open ne		1	0							0	0	0	0		12.1	0.58		1	3	1	5	1	1	1	2	2	1	0	0	3	3	2		1	1	1
12	3	25/06/2014	63	1	68	163	25.59	2	bladder tu	turt		1	1	1	1	0	0	0	0	0	0	0	0		10.8	1.2		2	5	5	5		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
13	2	25/06/2014	50	2	53	167	19	2	ca cx post	ileal condu		1	1	0	0	0	0	0	1	0	0	0	0		10.7	0.66		3	1	1	3	1	0	1	1	1	1	0							1	1	1
14	3	27/06/2014	18	1	48	160	18.75	1	haematuri	cysto eua		1	0							0	0	0	0		12	0.76		1	5	1	3	1	1	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
15	1	27/06/2014	56	1	55	155	22.89	2	rt renal cal	rt pcnl		1	1	0	0	0	1	0	0	0	0	0	0		8.9	3.62		1	2	10	7	1	1	0	2	2	1	1	2	2	0	0		1	1	1
16	2	27/06/2014	28	2	37	150	16.44	1	rt non func	rt nephrec		1	0							0	0	0	0		12.7	1.5		3	1	10	4	1	0	0	1	1	0							1	1	1
17	3	27/06/2014	48	1	64	165	23.51	1	bladder tu	turbt		1	0							0	0	0	0		12.5	0.75		2	5	1	3		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	0	0
18	3	27/06/2014	45	1	77	173	25.73	2	lt ureteric	lt urs		1	1	0	1	0	0	0	0	0	0	0	0		13	1.02		2	5	1	3		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
19	2	27/06/2014	18	1	54	166	19.6	1	urethral ca	cystolitho		1	0							0	0	0	0		13.8	0.89		2	5	3	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
20	2	27/06/2014	54	2	53	152	22.94	2	post renal	ureteric re		1	1	1	1	0	1	0	0	0	0	0	0		9	1.4	4	3	1	5	4	1	0	0	1	1	0							1	1	1
21	2	30/06/2014	45	1	57	165	20.94		rt renal cal	rt pcnl		1	0							0	0	0	0		14.1	0.78		1	2	10		1	1	0	1	1	1	1	2	1	2	1		1	1	1
22	1	30/06/2014	54	2	47	147	21.75		reanl tcc	rt lap nepl		1	1	1	1	0	0	0	0	0	0	0	0		10.8	0.9		1	4	5	5	1	1	1	2	2	1	0	0	1	1	2	sand bags	1	1	1
23	3	30/06/2014	60	1	85	165	31.22	2	recurrent l	turt		1	1	1	1	0	0	0	0	0	0	0	0		14.2	0.98	4.2	2	5	1	3		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
24	2	02/07/2014	59	2	59	145	28.06	2	small capa	cysto eua,l		1	1	1	1	0	0	0	0	0	0	0	0		10.4	1.02		2	5	2	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
25	3	02/08/2014	67	1	56	165	20.57	2	bladder ou	cystolitho		1	1	0	0	0	0	0	1	1	1	0	0		14	0.63		2	5	2	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
26	1	02/07/2014	41	1	64	162	24.39	2	lt staghorn	pcnl		1	1	0	1	0	0	0	0	0	0	0	0		14.2	0.93		1	2	1	5	1	1	0	2	2	1	1	2	2	0	0		1	1	1
27	1	01/07/2014	18	1	55	172	18.59	1	lt non func	lap nephre		1	0							1	1	0	0		13.2	1.07		1	4	1	4	1	1	1	2	2	1	0	0	2	2	2		1	1	1
28	1	03/07/2014	50	1	49	162	18.67	2	lt rcc	lt lap radic		1	1	0	1	0	0	0	0	1	0	0	0		11.2	0.93	4.5	1	4	3	5	1	1	1	2	2	1	0	0	3	3	2	jelly head	1	1	1
29	2	08/07/2014	65	2	64	156	26.3	2	rt renal cal	rt pcnl		1	1	1	1	0	0	0	0	0	0	0	0		10.7	1.4		1	2	3	5	1	1	0	2	2	1	1	2	2	2	0		1	1	1
30	3	08/07/2014	53	1	71	166	25.77	2	penile urel	substitutio		1	1	1	0	0	0	0	0	1	0	0	0		12.7	1.15		3	5	1	4	1	0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	1
31	2	08/07/2014	28	2	63	149	28.38	1	viable kidn	lt lap neph		1	0							0	0	0	0		14.5	0.66	4.4	1	4	2	5	1	1	1	2	2	1	0	0	2	2	1		1	1	1
32	2	08/07/2014	37	1	59	171	20.18	1	lt kidney st	lt pcnl		1	0							0	0	0	0		12.7	1.21		1	2	2	3	1	1	0	2	2	1	1	2	1	0	0		1	1	1
33	2	09/07/2014	36	2	50	148	22.83	1	viable kidn	rt donor n		1	0							0	0	0	0		11.8	0.55	4.3	1	3	10	4	1	1	1	2	2	1	0	0	0	0	2		1	1	1
34	2	09/07/2014	55	1	45	164	16.73	2	lt renal cal	lt pcnl		1	1	0	0	0	1	0	0	0	0	0	0		27.2	1.36		1	2	5	5	1	1	0	2	2	1	1	2	1	1	0		1	1	1
35	3	10/07/2014	16	1	35	155	14.57	1	urethral st	substitutio		1	0							0	0	0	0		14	0.52		3	5	2	4	1	0	0	1	1	1	0	0	3	0	0		1	1	1
36	1	10/07/2014	41	1	65	175	21.22	1	rt puj obst	rt pyelopla		1	0							0	0	0	0		12.9	1.2		1	3	3	4	1	1	0	2	2	1	1	0	0	2	0	2	rt arm on l	1	1	1
37	2	10/07/2014	63	1	76	165	27.92	2	lt renal ma	lt partial n		1	1	1	0	0	0	0	0	1	0	0	0		14	1.15	4.4	3	3	5	6	1	1	1	0	2	2	1	0	0	3	0	2		1	1	1
38	1	10/07/2014	35	2	50	163	18.82	2	chronic ren	rt allograf		1	1	0	1	0	1	0	0	0	0	0	0		9.8	1.45	3.6	1	1	1	2	1	0	0	1	1	0							1	1	1
39	2	14/07/2014	54	1	60	164	22.31	2	lt puj calcu	lt lap neph		1	1	1	0	0	0	0	0	1	0	0	0		11	1.88		1	3	3	5	1	1	0	2	2	1	0	0	2	2	2		1	1	1
40	3	14/07/2014	50	1	72	172	24.34	1	urethral st	buccal ure		1	0							0	0	0	0		12.3	0.86		3	6	1	3	1	0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
41	2	15/07/2014	59	1	55	158	22.03	2	tcc bladde	turt		1	1	1	0	0	0	0	0	0	0	0	0		11	1.4		2	5	2	4				1	1	1	0	0	0	0	0	leg stirrup	1	1	0
42	1	15/07/2014	39	1	65	164	24.17	2	non func k	rt lap nepl		1	1	0	1	0	0	0	0	0	0	0	0		13.6	0.93	4.7	1	3	4	8	1	1	1	2	2	1	0	0	0	2	1	2		1	1	1
43	2	21/07/2014	34	1	65	164	24.17	2	rectouretl	rectouretl		1	1	1	0	0	0	0	0	0	0	0	0		13	0.56		1	5	2	5	1	0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	1
44	2	22/07/2014	39	2	45	149	20.27	1	viable kidn	lt lap dono		1	0							0	0	0	0		11.9	0.71	4.4	1	3	1	6	1	1	1	2	2	1	0	0	3	3	2	stirrup lt h	1	1	1
45	2	22/07/2014	51	2	38	153	16.23	1	tcc bladde	radical cys		1	0							0	0	0	0		10.9	0.73	4.1	2	5	2	4	1	0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	1
46	4	22/07/2014	51	1	64	165	23.51	2	rt rcc lowe	rt lap nepl		1	1	0	1	0	0	0	0	0	0	0	0		15.1	0.8	4.8	1	3	10	6	1	1	1	2	2	1	0	0	0	1	1	2		1	1	1
47	4	25/07/2014	44	1	73	165	26.81	1	rt non func	rt lap nepl		1	0							0	0	0	0		14.4	0.83		1	3	15	6	1	1	1	2	2	1	0	0	2	3	0	3		1	1	1
48	3	25/07/2014	53	1	96	168	34.01	2	stricture u	substitutio		1	1	0	1	0	0	0	0	0	0	0	0		13.4	0.99		1	5	1	4	1	0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	1
49	2	25/07/2014	57	1	73	172	24.68	2	stricture u	eiu		1	1	1	0	0	0	0	0	0	0	0	0		13	0.8	4.3	2	5	2	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
50	1	25/07/2014	63	1	62	162	23.62	1	bph	turp		1	0							0	0	0	0		14.6	1.09		2	5	5	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	1
51	1	28/07/2014	68	2	65	155	27.06	2	lt ureteric	lt urs		1	1	1	1	0	0	0	1	0	0	0	0		13.3	0.74		2	5	5	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
52	3	28/07/2014	62	1	69	167	24.74	1	bph	turp		1	0							0	0	0	0		12	1.4		2	5	1	3		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
53	3	28/07/2014	33	1	68	170	23.53	1	papillary tu	turt		1	0							0	0	0	0		10	0.95	5.3	2	5	1	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
54	3	28/07/2014	74	1	53	162	20.2	2	ca prostate	sub cap pr		1	1	1	0	0	0	0	0	0	0	0	0		13.2	1.01		2	5	1	2		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
55	3	28/07/2014	62	1	54	162	20.58	1	bph with b	turp		1	0							0	0	0	0		11	0.88		2	5	1	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
56	2	28/07/2014	33	1	60	162	22.86	2	ca testis	dj stenting		1	1	0	0	0	0	0	1	0	0	0	0		13.3	0.74		2	5	2	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
57	2	28/07/2014	51	1	52	156	21.37	2	bulbar urtl	anastomot		1	1	0	1	0	0	0	0	0	0	0	0		12.1	0.54		2	5	2	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
58	1	28/07/2014	36	1	51	160	19.92	1	rt staghorr	rt pcnl		1	0							0	0	0	0		15	0.64		1	2	2	6	1	1	0	2	2	1	1	2	2	1		1	1	1
59	1	28/07/2014	56	1	68	168	24.09	2	lt renal cal	lt pcnl		1	1	1	1	0	0	0	0	0	0	0	0		13.1	0.56		1	2	1	6	1	1	0	2	2	1	1	2	2	2	0	armboard	1	1	1
60	1	28/07/2014	46	1	74	170	25.61	1	rt renal cal	rt urs		1	0							0	0	0	0		13.4	1.04		2	5	1	3		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
61	3	28/07/2014	59	1	55	167	19.72	2	lt bpp	tuip		1	1	1	0	0	0	0	0	0	0	0	0		8.5	1.82		2	5	1	4				1	1	1	0	0	0	0	0	leg stirrup	1	1	0
62	3	29/07/2014	52	1	75	163	28.23	1	urethral st	eiu		1	0							0	0	0	0		11.9	0.95		2	5	1	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
63	3	29/07/2014	35	1	70	166	25.4	1	prox bulba	eiu		1	0							0	0	0	0		12	0.79		2	5	1	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
64	1	29/07/2104	42	1	63	175	20.57	2	rt non func	rt lap nepl		1	1	0	1	0	0	0	0	0	0	0	0		15.8	1.04		1	3	10	6	1	1	1	2	2	1	0	0	2	2	1	2		1	1	1
65	3	29/07/2014	37	1	51	160	19.92	2	bladder ne	bni		1	1	0	0	0	1	0	0	1	0	0	0		6.1	2.95		2	5	1	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	0			
66	2	29/07/2014	37	1	55	150	24.44	2	bilateral re	b/l pcnl		1	1	0	1	0	0	0	0	0	0	0	0		13.9	1.12		1	2	5	5	1	1	0	2	2	1	1	2	1	2	2	armboard	1	1	1
67	2	29/07/2014	29	1	63	148	28.76	1	lt ureteric	lt urs		1	0							0	0	0	0		10.6	1.29		2	5	3	3		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
68	3	29/07/2014	80	1	79	165	29.02	1	bpe,boo	turp		1	0							0	0	0	0		12.8	0.96		2	5	1	3		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
69	3	29/07/2014	68	1	62	172	20.96	2	boo,bph	turp		1	1	1	1	0	0	0	1	1	0	0	0		12.2	1.03		1	5	1	3	1	0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	1
70	1	29/07/2014	75	2	38	154	16.02	2	radiaton c	bladder wa		1	1	0	0	0	0	0	1	0	0	0	0		6.8	0.7		2	5	1	3		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
71	2	29/07/2014	70	1	60	157	24.34	2	nephrolith	lt urs		1	1	1	0	0	0	0	0	0	0	0	0		11.8	2.18	4.2	2	5	3	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
72	2	30/07/2014	36	2	70	159	27.69	1	viable kidn	lt lap dono		1	0							0	0	0	0		11	1		1	3	5	6	1	1	1	2	2	1	0	0	2	2	2		1	1	1
73	2	30/07/2014	20	1	45	149	20.27	1	urethral ca	urs		1	0							0	0	0	0		12.6	1.09		2	5	1	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
74	3	30/07/2014	81	1	51	156	20.96	1	ca prostate	turp b/l or		1	0							0	0	0	0		13	0.84		1	5	1	4	1	0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
75	3	30/07/2014	64	1	73	157	29.62	2	bph, boo	turp		1	1	0	0	0	0	0	1	0	0	0	0		12.5	0.98		2	5	1	3	1	0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
76	3	31/07/2014	74	1	75	167	26.89	1	ca prostate	turp,orchi		1	0							0	0	0	0		11	1.2		2	5	1	4		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
77	3	31/07/2014	41	1	47	156	19.31	1	multiple ur	substitutio		1	0							0	0	0	0		15	0.65		3	5	5	4	1	0	0	1	1	1	0	0	3	3	0	leg stirrup	1	1	0
78	3	31/07/2014	26	1	76	173	25.39	1	undescenc	orchidope		1	0							0	0	0	0		16.7	0.91		2	1	1	4		0	0	1	1	1	0							1	1	0
79	3	31/07/2014	60	1	64	161	24.69	2	urethral st	substututi		1	1	0	1	0	0	0	0	0	0	0	0		13	1.05		1	5	2	4	1	0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	1
80	3	20/06/2014	63	1	76	170	26.3	2	bph, cysto	turp,cysto		1	1	1	0	0	0	0	0	0	0	0	0		13.2	0.86	4.4	2	5	1	3		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
81	2	01/08/2014	47	1	67	161	25.85	1	rt ureteric	pcnl		1	0							0	0	0	0		12.4	1.07		1	2	3	6	1	1	0	2	2	1	1	2	1	2	1		1	1	1
82	2	01/08/2014	40	1	68	166	24.68	1	rt renal cal	rt pcnl		1	0							0	0	0	0		14	0.88		1	2	3	6	1	1	0	2	2	1	1	2	1	2	1		1	1	1
83	1	01/08/2014	52	2	56	156	23.01	2	rt staghorr	rt pcnl		1	1	1	1	0	0	0	0	0	0	0	0		11.7	1.22		1	2	3	6	1	1	0	2	2	1	1	2	1	2	1		1	1	1
84	1	01/08/2014	60	1	65	157	26.37	2	lt mid uret	lt urs		1	1	1	0	0	0	0	0	0	0	0	0		13.6	1.01	4.7	2	5	2	3		0	0	1	1	1	0	0	0	0	0	leg stirrup	1	1	0
85	3	01/08/2014	57	1	70	170	24.22	2	urethral st	eiu		1	1	1

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hotline	duration	hr	sbp	dbp	spo2	temp	vasop	vasoinfu	vasointe	hypoten	adults	child	crystall	colloids	blood	bloodpro	tbl	tuo	pinjury	eyes	redness	chemosis	corneal	conjunct	visual	blind	pedema	headneck	hnsp	hnsti	earnose	lip	chin	hnothers	chestabd	casp	bruising	casti	breasts	genitalia	ll	skinedemz	llsti	llcs	nerve	dvt
0	150	85	150	100	96	36	0			0			2.5	0	0	0	0.3	300	0																											
0	60	70	145	70	96		0			0			1	0	0	0	0.2	500	0																											
0	180	80	130	80	96	36	0			0			1	0	0	0	0.3	300	0																											
0	90	70	130	80	100		0			0			1	0	0	0	0.5		0																											
0	75	80	110	80	100		0			0			0.5	0	0	0	0.5		0																											
0	90	90	120	70	100	35.8	0			0			1	0	0	0	0.2		0																											
0	240	80	120	80	100		0			0			1.5	0	0	0	0.55		0																											
0	120	78	140	80	100	36	0			0			1.5	0	0	0	0.1	500	0																											
0	110	84	140	86	100	35.8	2		3	0			2	0	0	0	0.15	500	1	1	1	1	0	0	0	0	1	1	0	0	0	1	0	0	0						0					
0	120	80	93	49	100	35.5	0			0			1	0	0	0	0.2		0																											
0	120	121	138	60	100	36	0			0			1	0	0	0	0.4	450	0																											
0	60	117	171	84	100		0			0			0.5	0	0	0	0.2		0																											
0	360	80	110	60	96	35.5	1	1	2	1	1	0	2.5	0	0	0	0.1	0	0																											
0	60	74	100	70	99	36	2		3	0			0.5	0	0	0	0.05		0																											
0	150	70	160	100	98	35.9	0			0			1	0	0	0	0.8		0																											
0	300	124	102	64	100	35.5	0			0			3	0.5	0	0	0.5		0																											
0	150	70	120	60	99		0			0			1	0	0	0	0.1		0																											
0	60	80	145	86	99		0			0			0.5	0	0	0	0.1		0																											
0	60	72	110	60	98		0			0			1	0	0	0	0.1		0																											
0	240	82	130	54	100	35.8	0			0			1.5	0	0	0	0.2	500	0																											
0	135	84	120	80	100	35.5	0			0			1.5	0	0	0	0.25		1	1	1	0	0	0	0	0	1	1	0	0	0	1	0	0	0						0					
0	210	85	130	80	100	36.2	0			0			1.5				0.8	800	0																											
0	60	70	130	80	99		2		2	0			0.75	0	0	0	0.2		0																											
0	50	60	120	80	100		0			0			0.5	0	0	0	0.05		0																											
0	2	69	130	70	98		0			0			2	0	0	0	0.8		0																											
0	120	80	130	80	100	35.5	0			0			1.5	0	0	0	0.5		0																											
0	120	80	130	80	100	36	2		2	0			1	0	0	0	0.1	500	0																											
0	180	60	145	85	100	35.9	2		2	0			1.5	0	0	0	0.1	500	0																											
0	150	88	200	110	96	36	2		3	0			1.5	0	0	0	0.35	800	0																											
0	240	80	120	80	100	36	0			0			2	0	0	0	0.5		0																											
0	300	90	110	70	100	36	2		4	0			3.5	0	0	0	0.5	500	0																											
0	120	64	140	82	100	35.5	0			0			2.5	0	0	0	0.25	600	0																											
0	180	80	110	70	100	36	2		3	0			3	0	0	0	0.1	500	0																											
0	150	56	112	70	100	35.8	0			0			1				0.3		0																											
0	240	70	100	60	100	36	0			0			1.5	0	0	0	0.5		0																											
0	180	90	110	70	100	36	0			0			1.5	0	0	0	0.6	600	0																											
0	150	80	140	70	100	36	0			0			3	0.5	0	0	0.15	500	0																											
0	270	80	130	80	100	35.8	0			0			4	0	0	0	0.8	2900	0																											
0	120	80	140	90	100	35.8	0			0			2	0	0	0	0.25	350	0																											
0	330	80	120	80	100	36	0			0			2	0	0	0	0.8		0																											
0	60	80	130	80	100		0			0			0.5	0	0	0	0.1		0																											
0	150	60	110	60	100	35.8	0			0			2	0	0	0	0.3	500	0																											
0	240	82	126	80	100	36	0			0			2	0	0	0	0.6	600	0																											
0	120	98	122	88	100	36	0			0			8	0	0	0	0.5	2000	0																											
0	540	100	130	80	100	35.5	1	1	5	0			4	0.5	0.35	0	0.45		1	0								0							0						1	1	0	0	0	0
0	150	60	90	60	100	35.8	0			0			2	0	0	0	0.2	400	0																											
0	180	60	110	70	100	36	0			0			2	0	0	0	0.08	400	0																											
0	300	100	150	95	100	35.5	0			0			1.5	0	0	0	0.3		0																											
0	30	88	160	90	100		0			0			1	0	0	0			0																											
0	120	60	110	60	100		0			0			0.5	0	0	0	0.5		0																											
0	45	95	170	90	100		0			0			1	0	0	0			0																											
0	75	85	130	80	100		0			0			0.5	0	0	0	0.3		0																											
0	45	75	130	80	100		0			0			1	0	0	0	0.1		0																											
0	90	85	130	80	97		2		3	0			0.5	0	0	0	0.1		0																											
0	45	102	150	90	100		0			0			0.5	0	0	0	0.5		0																											
0	30	140	130	80	100		0			0			1	0	0	0			0																											
0	150	100	160	100	100		0			0			2	0	0	0	0.5		0																											
0	90	80	130	80	100	35.5	0			0			2	0	0	0	0.8		0																											
0	120	90	120	80	100	35.6	0			0			1.5	0	0	0	0.8		0																											
0	60	80	130	80	100		0			0			0.5	0	0	0	0.02		0																											
0	45	100	130	65	100		0			0			0.5	0	0	0	0		0																											
0	45	55	120	80	100		0			0			1	0	0	0	0		0																											
0	45	88	130	80	100		0			0			1	0	0	0	0		0																											
0	120	80	120	90	100	36	0			0			1.5	0	0	0	0.3	500	0																											
	45	80	130	80	100		0			0			0.2	0	0	0	0		0																											
0	240	82	126	64	100	35.5	2		5	0			1.5	0	0	0	0.3		0																											
0	90	76	126	76	100		0			0			1	0	0	0	0		0																											
0	45	69	160	80	95		0			0			0.5	0	0	0	0.5		0																											
0	1	110	140	80	97	35.5	0			0			0.5	0	0	0	0.5		0																											
0	30	80	110	80	96		0			0			1	0	0	0	0.05		0																											
0	90	103	160	90	100		0			0			1	0	0	0	0.05		0																											
0	150	110	120	80	100	36	2		3	0			2.5	0	0	0	0.4	1000	0																											
0	60	59	150	82	100		0			0			1.5	0	0	0	0		0																											
0	120	60	132	73	100		0			0			0.5	0	0	0	0.5		0																											
0	60	67	122	68	100		0			0			0.6	0	0	0	0.4		0																											
0	120	60	110	80	100		0			0			1	0	0	0	0.2		0																											
0	240	65	97	58	100	36	2		4	0			2	0	0	0	0.5		0																											
0	60	100	120	80	100		0			0			1	0	0	0	0.1		0																											
0	150	60	140	70	99	36	0			0			2	0	0	0	0.1		0																											
0	120	60	120	70	100		0			0			0.5	0	0	0	0.5		0																											
0	120	80	120	80	100	35.5	0			0			2	0	0	0	0.8		0																											
0	120	80	130	80	100	35.7	0			0			1.5	0	0	0	0.5		0																											
0	180	80	120	80	100	35.5	0			0			1.5	0.5	0	0	0.8		0																											
0	60	85	154	74	100		0			0			1.5	0	0	0	0		0																											
	30	110	160	90	100	35.5	0			0			0.5	0	0	0	0.05		0																											
0	60	78	132	76	100		0			0			0.5	0	0	0	0.3		0																											
0	45	76	160	84	100		2		1	0			0.5	0	0	0	0.2		0																											
0	240	76	116	64	100	35.9	2		4	0			1	0	0	0	0.4		0																											
0	420	94	140	94	100	35.6	2		8	0			12	0	0.35	0	1.2	2000	0																											
0	90	78	100	60	100		0			0			0.5	0	0	0	0.5		0																											
0	150	102	118	72	100	35.8	0			0			1.5	0	0	0	0.7	600	0																											
	45	80	120	80	100		0			0			0.5	0	0	0	0		0																											
	40	65	149	90	100		0			0			0.5	0	0	0	0.05	100	0																											
0	90	68	138	80	100		0			0			0.7	0	0	0	0.4		0																											
0	300	80	142	66	100	35.8	0			0			5.2	0	0	0	0.6	1400	0																											
0	90	86	132	80	100		2		2	0			1	0	0	0	0		0																											
0	240	70	112	73	100	36	0			0			1.5	0	0	0	0.45	100	0																											
0	120	70	140	80	99	36.1	0			0			1.5	0	0	0	0.5	500	0																											
0	150	75	100	60	100	36	0			0			2	0	0	0	0.3	1000	0																											
0	100	91	128	62	100		0			0			1	0	0	0	0.4		0																											
0	105	89	134	63	98		0			0			0.7	0	0	0	0.3		0																											
0	180	75	130	80	100	36.8	0			0			1.5	0	0	0	0.5	600	0																											

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0	30	82	130	90	100		0			0			0.5	0	0	0	0		0
0	150	90	120	70	100		0			0			1.5	0	0	0	0.5		0
0	60	90	120	70	100		0			0			1	0	0	0	0.35		0
0	70	80	140	90	100		0			0			0.5	0	0	0	0.35		0
0	45	75	110	80	100		0			0			0.5	0	0	0	0		0
	30	88	132	86	100	36	0			0			0.5	0	0	0	0		0
	60	120	138	80	100		0			0			0.5	0	0	0	0.05		0
	45	120	138	80	100		0	2	2	1	1		0.5	0	0	0	0.08		0
	20	85	120	80	100	36	0			0			0.5	0	0	0	0		0
	90	60	127	60	100		0			0			0.65	0	0	0	0.02		0
	40	62	140	80	100		0			0			0.5	0	0	0	0		0
	45	70	130	70	98		0			0			0.5	0	0	0	0.02		0
	45	65	125	72	100	36.7	0			0			0.5	0	0	0	0.02		0
	40	82	160	74	100		0			0			0.5	0	0	0	0.05		0
	40	70	120	70	100		0			0			0.5	0	0	0	0	0	0
	35	70	120	70	100		0			0			0.5	0	0	0	0	0	0
0	180	49	110	90	100		0			0			2	0	0	0	0.4	150	0
0	60	68	160	90	100		0			0			0.5	0	0	0	0	0	0
0	90	80	130	80	100		0			0			1	0	0	0	0.5	0	0
0	40	80	120	76	100		0			0			0.5	0	0	0	0	0	0
0	105	97	97	67	100	36.1	0			0			1	0	0	0	0.4		0
0	180	116	118	64	100	35.5	0			0			1	0	0	0	0.25		0
0	240	80	140	80	100	36.5	0			0			1.5	0	0	0	0.2	200	0
1	360	85	170	80	100	36.4	1	1		0			6.5	0	0.75	0	1.8		0
0	150	96	106	80	100		2		3	1	0	0	1.5	0	0	0	0.5		0
0	150	78	116	80	100	36.8	0			0			1	0	0	0	0.4	0	0
0	90	72	105	71	100		0			0			0.6	0	0	0	0	0	0
0	80	67	160	103	100		0			0			0.5	0	0	0	0.01	0	0
0	70	74	957	0	100		0			0			0.3	0	0	0	0.1	0	0
0	60	78	120	70	100	35.3	0			0			1	0	0	0	0.1	0	0
0	60	52	120	62	100		0			0			1	0	0	0	0	0	0
0		76	156	82	100		0			0			1	0	0	0	0		0
	60	84	130	80	100		0			0			1	0	0	0	0	0	0
	60	62	110	80	100		0			0			1	0	0	0	0	0	0
	45	60	130	70	100		0			0			1	0	0	0	0	0	0
1	200	95	140	100	100		2		2	0			8	0	0	0	0.5	900	0
0	120	70	160	80	100	36	2		6	1	0	0	3.5	0	0	0	2.5	0	0
	60	72	140	82	100		0			0			0.5	0	0	0	0	0	0
0	60	68	110	80	100		0			0			1	0	0	0	0	0	0
0	60	62	130	80	100		0			0			1	0	0	0	0	0	0
	45	68	120	68	100					0			1.5	0	0	0	0	0	0
0	150	110	140	90	100	36.2	0			0			1	0	0	0	0.2	0	0
0	75	90	120	70	100		0			0			2	0	0	0	0.3		0
0	60	80	120	80	100		2		2	1	0	0	1	0	0	0	0.1		0
0	240	70	110	80	97	36	0			0			1.5	0	0	0	0.2	400	0
0	120	103	140	90	100		0			0			1	0	0	0	0	0	0
	60	85	160	90	100		0			0			1	0	0	0	0	0	0
	60	52	126	80	100		0			0			1	0	0	0	0	0	0
0	90	80	120	76	100	36	0			0			0.5	0	0	0	0	0	0
0	60	701	207	4	100	36.2	0			0			1	0	0	0	0	0	0
0	40	65	100	74	100		0			0			0.5	0	0	0	0	0	0
0	60	110	100	70	100		0			0			1	0	0	0	0	0	0
0	60	92	130	80	100		0			0			0.5	0	0	0	0	0	0
0	180	100	140	80	100		0			0			1	0	0	0	0.25		0
0	30	44	116	80	100		0			0			0.5	0	0	0	0	0	0
0	60	65	130	86	100		0			0			0.5	0	0	0	0	0	0
	25	60	120	70	100		0			0			0.25	0	0	0	0.02	0	0
	20	60	120	70	100		0			0			0.25	0	0	0	0.02	0	0
	30	75	140	90	100		0			0			0.25	0	0	0	0	0	0
	30	66	120	70	100		0			0			0.25	0	0	0	0.01	0	0
	45	62	130	80	99		0			0			0.25	0	0	0	0	0	0
	60	75	165	74	100		2		3	1	0	0	0.6	0	0	0	0	0	0
	60	85	125	90	99		0			0			0.7	0	0	0	0	0	0
	30	84	130	90	100		0			0			0.4	0	0	0	0	0	0
	45	92	130	70	100		0			0			1	0	0	0	0		0
	45	68	130	70	100		0			0			0.5	0	0	0	0.05		0
0	150	80	140	80	100	35.7	2		3	0			1.5	0	0	0	0.5		0
	45	84	120	80	100		0			0			0.5	0	0	0	0.05		0
0	120	78	130	80	100	35.5	0			0			1.5	0	0	0	0.5		0
	60	85	130	90	100		0			0			0.7	0	0	0	0.02	0	0
0	90	55	136	80	100	36.6	0			0			1	0	0	0	0.1	0	0
0	35	96	150	80	100		0			0			0.5	0	0	0	0.2	0	0
	45	81	140	80	99		0			0			0.7	0	0	0	0	0	0
0	45	82	130	80	100		0			0			0.5	0	0	0	0.2	0	0
0	45	84	120	70	100		0			0			1	0	0	0	0.45	0	0
0	30	52	116	80	100					1	0	0	0.4	0	0	0	0	0	0
	60	88	160	104	100		0			0			0.5	0	0	0	0	0	0
	60	75	110	70	99	36.8				0			0.5	0	0	0	0	0	0
	45	85	120	80	100		0			0			0.7	0	0	0	0	0	0
0	120	70	99	60	100		0			0			1	0	0	0	0.2	0	0
0	45	68	160	70	100		0			0			0.5	0	0	0	0.1	0	0
	45	68	120	70	100		0			0			0.5	0	0	0	0.1	0	0
1	120	60	110	70	100	35.3	0			0			1	0	0	0	0.3	0	0
0	60	78	130	80	100		0			0			0.6	0	0	0	0.05	0	0
0	150	74	150	100	100		0			0			1	0	0	0	0.3	0	0
0	35	80	130	60	100		0			0			1	0	0	0	0	0	0

vascular	peripher	gangrene	bpul	palsy	paresis	bpedema	bpcs	priothers	pinciden	hd	hypo	brady	airway	tube	tkink	textub	pcautery	cburns	va	arterial	mva	monitorin	monitord	hypother	otherinc
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1	0			1	1	0	0		0	0		0	lma dislodgement
1	1	1	0	0					0	0		0	left lung compressed/icd